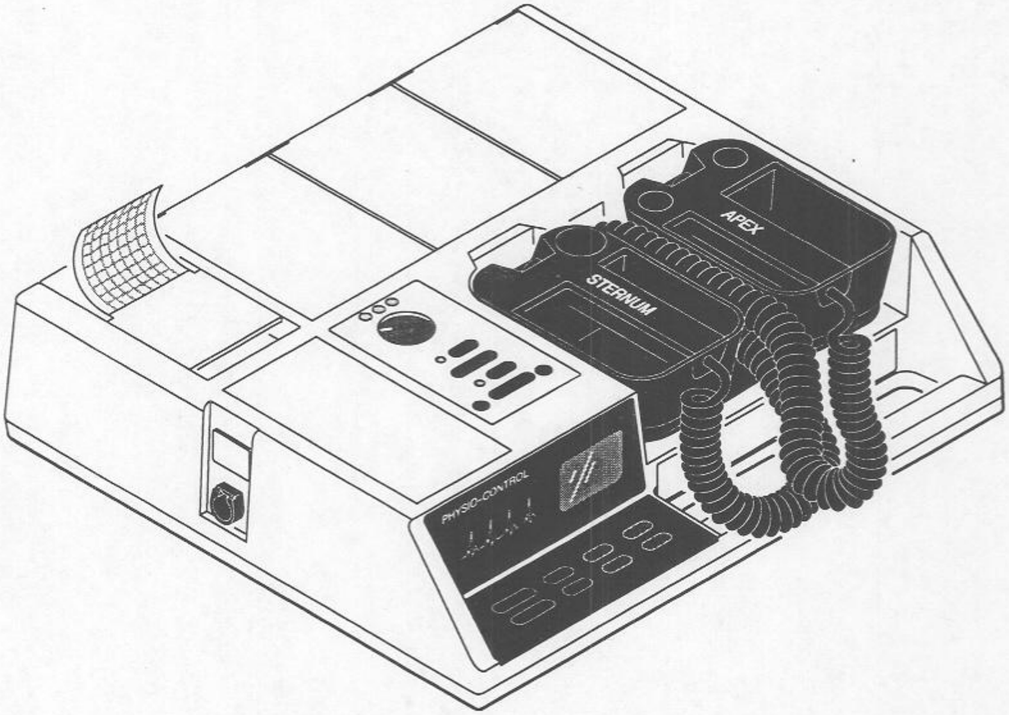
Service Manual

LIFEPAK® 10 defibrillator/monitor/pacemaker



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About This Manual: This Service Manual is intended for use by technical service personnel. It describes how to maintain, test, troubleshoot, and repair the LIFEPAK 10 defibrillator/monitor/pacemaker.

A separate publication, the ***Operating Instructions***, is intended for use by physicians, clinicians, and emergency care personnel. It provides step-by-step instructions for all operating features of the LIFEPAK 10 defibrillator/monitor/pacemaker as well as operator-level testing and maintenance.

Device Tracking

(US only, including US government-owned units)
Under the Safe Medical Devices Act of 1990, defibrillator manufacturers and distributors are required to track the location of defibrillators. If your defibrillator has been sold, donated, lost, stolen, exported, or destroyed, or if it was not obtained directly from Physio-Control, please notify Physio-Control at 1.800.442.1142, extension 4530.

Trademarks

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Warranty

Refer to the product warranty statement included in the accessory kit shipped with the product. Duplicate copies may be obtained by contacting your local Physio-Control sales or service office.

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Safety Information

Introduction

This section introduces terms and symbols used in this manual or on the equipment to alert both operating and service personnel of recommended precautions in care, use and handling of this specialized medical equipment.

Terms

Certain terms are used in this manual or on the equipment. Familiarize yourself with their definitions and significance.

Danger: Immediate hazards which **will** result in serious personal injury or death.

Warning: Hazards or unsafe practices that **could** result in serious personal injury or death.

Caution: Hazards or unsafe practices that **could** result in minor personal injury or product damage.

Note: Points of particular interest for more efficient or convenient instrument operation; additional information or explanation concerning the subject under discussion.

General Warnings and Cautions

Following are descriptions of general hazards that could result in death, serious injury or product damage. Specific warnings and cautions not appearing in this section are found throughout the manual.

⚠ WARNINGS

Possible fire or explosion. Do not use this device in the presence of flammable gases or anesthetics. Use care when operating this device close to oxygen sources (such as bag-valve-mask devices or ventilator tubing).

Shock or fire hazard. Do not immerse any portion of this device in water or other fluids. Avoid spilling any fluids on device or accessories. Do not clean with ketones or other flammable agents. Do not autoclave or sterilize this device or accessories unless otherwise specified.

Patient hazard. Do not mount device directly above patient. Place the device in a location where it cannot harm the patient should it fall from its shelf or other mount.

Shock or fire hazard. Equipment or accessories improperly interconnected to each other can be a source of ignition or cause a shock. Make sure that all equipment is interconnected safely in accordance with NFPA 70-1994, **National Electric Code**.

Note: Within certain govermental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. It is important that you verify and observe the required applications in your location. Check leakage current and grounding requirements after interconnecting this device with accessory equipment.

⚠ CAUTIONS

Possible device damage. This device may be damaged by mechanical/physical abuse (e.g., immersion in water, drop exceeding 30 inches with carrying case, drop exceeding 18 inches without carrying case).

Possible device damage. To help prevent component damage, do not mount device near vibration sources such as engine struts and landing gear.

Possible device damage. Broken or frayed wires, or loose snap fittings may cause interference or loss of signal. Pay particular attention to the point at which the wires enter the terminals. Repeated flexing at these points eventually causes the wire strands to break. Perform frequent electrical and visual inspections of cables and wires.

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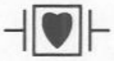
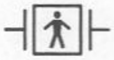
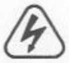
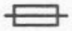
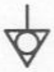
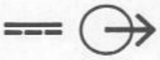
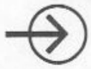
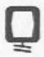
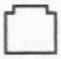
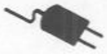
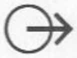
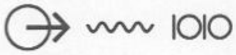
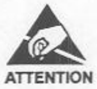
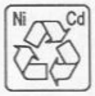
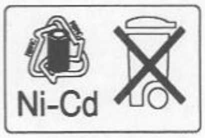
Symbols

The following symbols appear in this manual or on the equipment.

○	Off (power: disconnection from the AC mains)
|	On (power: connection to the AC mains)
	Defibrillation protected, type CF patient connection
	Defibrillation protected, type BF patient connection
⚠	On labels: Attention, consult accompanying documents On status display: Contact qualified service technician
	Caution, high voltage
⏚	Protective earth (ground)
	Fuse
	Equipotentiality connector
+	Positive input terminal
–	Negative input terminal
	12V DC output cable
	12V DC input cable
	Paddles
	Battery
	Plug
	Output
~	AC current
	Output AC/Digital
	Static Sensitive Device (SSD)
	Recycle battery
	Recycle battery

General Information

Service Information

Before attempting to clean or repair any assembly in this device, the technician should be familiar with the information provided in Section 4, **Service and Maintenance**.

A qualified technician should check a product that has been dropped, damaged, or abused, to confirm that the instrument is operating within performance standards listed in Section 3, **Performance Inspection Procedure (PIP)**, and to verify that leakage current values are within specifications.

Component replacement and internal adjustments must be made by service personnel qualified by appropriate training and experience.

If assistance in servicing the defibrillator is needed, contact your local Physio-Control service or sales representative. In the US, contact Physio-Control at 1.800.442.1142.

Effective Publication Dates

The effective publication date for each page of this manual is listed below.

Title	Page			Date
Trademark and Warranty	ii			September 1997
Table of Contents	iii	through	vi	September 1997
Safety Information	iii	through	v	September 1997
General Information	vi	through	ix	September 1997
1 Description	1-1	through	1-41	September 1997
2 Operation	2-1	through	2-14	September 1997
3 Testing	3-1	through	3-37	September 1997
4 Service and Maintenance	4-1	through	4-27	September 1997
5 Part Lists and Schematics	5-1	through	5-63	September 1997
Index	Index-1	through	Index-6	September 1997

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Configuration Information

This manual is current with the listed revision level of the following part numbers. The assemblies appear in the same order as in Table 5-1.

Ref	Assembly Name	Part Number	Rev
	Final Assembly	804200-28 through 41, 59, 62, 63	T1
A1	System PCB Assembly	806369-09, 13	D5
A2	Chart/Pacer PCB Assembly	804202-20, 21, 22, 23	M3
A3	Anode Power Supply	804296-05	E
A4	Main Control Panel Assembly	804277-05 through 08	E1
A5	Pacer Control/Battery Indicator Panel Assembly	804196-16, through 21	F2
A6	Energy Select PCB Assembly	804258-02	B
A7	Recorder Assembly	804189-00	C1
A8	Paddle Assembly	804250-11 through 20	F5
A9	Status Display Module	805230-01	B1
A10	Relay Assembly	800240-12	W4
A11	CRT Assembly	806389-00	Orig2
A12	CRT PFC Assembly (part of A11)	805078-01	E1
A15	MIEMSS Modulator PCB Assembly	805608-01	C4
W1-W11	Wire Harnesses, LP10	805115-00 through 04, 07, 09, 10, 13, 14, 21	F3
W12	Cable, Pacer, LIFEPAK 10	804249-00	C1
W13	Cable, Control, LIFEPAK 10	804252-01	C3
W14	Cable, Recorder, LIFEPAK 10	804253-00	C
W15	Cable Assembly, Ribbon, MIEMSS	805628-00	A
W16	Cable Assembly, Output Modification	805629-00	A3
	12 Lead ECG Adapter	805600-00 through -06	E4

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Overview

This manual contains the following information:

Section 1

Description: This section details how the instrument works. Input signals, power supplies, PCB functions, and instrument outputs are described. Each PCB circuit description is accompanied by a block diagram to illustrate the principle circuit components. Circuit names in these block diagrams correspond to those in the appropriate schematics in Section 5.

Section 2

Operation: This section familiarizes the user with basic equipment function. It identifies controls, indicators, connectors, and screen menu options. This section is not intended to provide instruction in the clinical use of the instrument; a separate *Operating Instructions* is available for that purpose.

Section 3

Testing and Troubleshooting: This section contains Performance Inspection Procedures (PIP)—the sequential steps to follow when performing an operational closed-case check of the equipment. This section also contains Test and Calibration Procedures (TCP) and troubleshooting aids to help with troubleshooting and repair.

Section 4

Service and Maintenance: This section provides disassembly/reassembly procedures for removing the major subassemblies. The procedures are referenced to numbered parts in the Final Assembly drawing in Section 5. This section also includes instruction for inspecting, cleaning, maintaining, and repairing the device.

Section 5

Parts Lists and Schematics: This section contains a list of supplies and accessories, parts lists, PCB assembly drawings, and schematic diagrams for repairable/replaceable components, subassemblies, and assemblies.

Section 1

Description

Introduction

This section provides general descriptions for the LIFEPAK 10 defibrillator/monitor/pacemaker. The section is divided into three parts:

- Physical Description describes general features and lists specifications
- Functional Description briefly describes the circuitry at a functional block level
- Theory of Operation provides detailed circuit descriptions to a major component level

Physical Description

The LIFEPAK 10 defibrillator/monitor/pacemaker is a portable device which offers dc defibrillation, electrocardiogram (ECG) monitoring, and noninvasive pacing. Any one of three rechargeable nickel-cadmium (NiCad) batteries or an optional 120Vac, 220Vac, or 12Vdc Auxiliary Power Module supplies power for the device.

The defibrillator delivers a controlled monophasic dc defibrillating pulse at any one of eight selectable energy levels ranging from 5 to 360 joules. Defibrillation pulses may be delivered through standard paddles, clip-on posterior or pediatric paddles, or FAST-PATCH™ defibrillation/ECG electrodes (requires a FAST-PATCH adapter).

The defibrillator also offers synchronization for cardioversion whereby delivery of a defibrillation pulse is synchronized with detection of the QRS portion of an electrocardiogram.

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Most of the defibrillator controls are located on the paddles. A rotary switch on the STERNUM paddle selects the energy level of the defibrillation pulse. Pressing the CHARGE button on the APEX paddle initiates the energy charging. Simultaneously pressing buttons on both paddles initiates delivery of the pulse. Pressing the SYNC button on the device front panel initiates the synchronized mode.

While the device charges up to the selected energy level, a tone rising in pitch is emitted, an LED flashes next to the CHARGE button, and the increasing energy level shows on the front panel liquid crystal display (LCD) under the caption AVAILABLE ENERGY. After a full charge is reached, a single tone is emitted, the LED remains lit, and the selected energy level is displayed. If the energy is not discharged through the paddles within 60 seconds of reaching the full charge, the energy automatically discharges internally.

The monitor receives ECG signals through a shielded three-lead cable, the defibrillator paddles, or the FAST-PATCH electrodes. The monitor displays the ECG waveforms on a cathode ray tube (CRT) and can print the waveforms on a thermal strip chart recorder. The three-lead patient cable connects to the device through the ECG connector on the right side of the device.

Buttons on the main control panel control the operation of the monitor, CRT, and recorder. The operator can optimize QRS detection and display by increasing or decreasing the setting of ECG SIZE. The QRS VOL button allows the operator to adjust the volume of the audible beep emitted when a QRS is detected. The LEAD SELECT button allows selection of the lead for ECG input (paddles or leads I, II, or III).

Pressing RECORD starts the recorder. In addition to printing the ECG waveform, the recorder also prints the time, date, ECG lead, ECG size, heart rate, SYNC (if activated), and pacing parameters. Pressing CODE SUMMARY causes the recorder to print a summary of critical events such as defibrillation or cardioversion, ECG monitoring, or pacing parameters.

The CRT displays the ECG waveform moving at 25mm/s from right to left. By pressing and holding FREEZE, the waveform “freezes” on the display for further examination. Pressing CAL superimposes a 1mV calibration signal on the CRT and recorder.

The optional noninvasive pacemaker allows output of a monophasic dc pacing current. The pacemaker control panel on the top of the device controls the pacing functions. The strength of the output current may be varied by increments of 5 or 20mA up to 200mA, and the rate may be varied between 40 and 170 beats per minute (bpm) by increments of 10bpm. The pacemaker operates "on demand." While in the pacing mode, the device examines the ECG waveform from the patient and delivers the pacing current only when normal QRS activity is not detected. The pacing current is delivered through QUIK-PACE® disposable noninvasive pacing electrodes that are attached through the PACE connector on the left side of the device.

The AUX connector on the left side of the device provides output for transmission of modulated or unmodulated ECG data. It also allows connection of a 120Vac, 220Vac, or 12Vdc Auxiliary Power Module. The Power Module supplies operating power while also trickle-charging any of the batteries installed in the device. The Physio-Control Battery Support System must be used to properly maintain batteries as described on page 4-3. An optional 12-lead adapter is available to allow acquisition of serial diagnostic-quality 12-lead ECG recordings.

The LIFEPAK 10 defibrillator/monitor/pacemaker is shown in Figure 1-1. Specifications for the device are provided in Table 1-1.

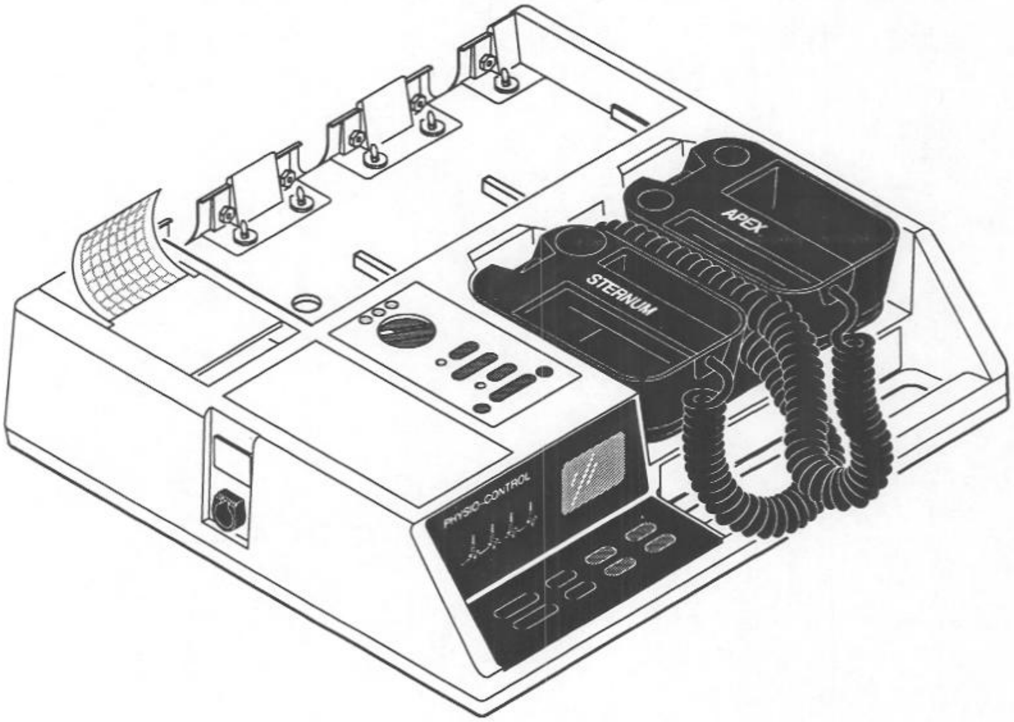

Figure 1-1 LIFEPAK 10 defibrillator/monitor/pacemaker

Table 1-1 LIFEPAK 10 defibrillator/monitor/pacemaker General Specifications

ECG Monitor	ECG Lead Selection	Paddles, I, II, or III
	Input	Isolated ECG via QUIK-LOOK defibrillation paddles, FAST-PATCH electrodes, or 3-lead patient ECG cable
	Electrical Isolation and Shielding	Input protected against high voltage defibrillator pulses and radio frequency interference per FDA Standard MDS-201-0004. RF interference depends on distance from RF source, radio output power, radiating efficiency, vehicle environment, etc.
	3-Lead ECG Cable Length	4.0m (13ft) total length; 3.0m cable (10ft) with 0.9m leads (3ft)
	FAST-PATCH Therapy Cable Length (optional)	3.0m (10ft)
	Common Mode Rejection	Minimum 100dB with respect to chassis ground at 60Hz, 65dB minimum with respect to isolated ground when using 3-lead patient ECG cable
Cardioscope Display	Size	72.5mm (2.85 in) x 43.5mm (1.7 in)
	Sweep Speed	25mm/sec
	Frequency Response	Monitor (domestic): 1 to 30Hz, –3dB Monitor (agency): 0.5 to 25Hz, –1.4dB Expanded freq. response while recorder in DIAG mode: 0.05 to 30Hz, –3dB Paddles: 2 to 20Hz, –3dB
	Gain	17mm/1mV
Strip Chart Recorder	Paper Size	50mm x 30m (100 ft)
	Trace Center	±1.5mm
	Paper Speed	25mm/sec
	Gain	10mm/1mV
	ECG CAL Pulse	10 ±0.5mm
	Noise	<2.0mm
	Frequency response	Monitor (domestic): 1 to 30Hz, –3dB Monitor (agency): 0.5 (–1.4dB) to 40 (–3dB) Hz Diagnostic: 0.05 to 100Hz, –3dB Paddles: 2 to 20Hz, –3dB CODE SUMMARY frequency response: Domestic: 1 to 30Hz Agency: 0.5 to 40Hz
	Annotation	Time, date, lead, gain, heart rate, defibrillation and/or pacing parameters
	CODE SUMMARY critical event record	Digitally stored record of critical ECG and device parameters
Status Display	Heart Rate (bpm)	3-digit readout displays rates from 20 to 295 bpm
	Available Energy	0-360 joules
	Pacing Rate	40-170bpm
	Pacing Current	0-200mA
	DIAG message	Indicates recorder frequency response is .05 to 100Hz, –3dB

Table 1-1 LIFEPAK 10 defibrillator/monitor/pacemaker General Specifications *(continued)*

Monitor Controls	ECG SIZE	Adjusts ECG gain	
	QRS VOL	Adjusts loudness of QRS beeper	
	CAL	Sends calibration pulse to monitor input	
	CODE SUMMARY	Activates CODE SUMMARY printout	
	LEAD SELECT	Selects ECG Input: Paddles, I, II, or III	
	RECORD	Activates strip chart recorder; activates diagnostic mode if held for more than 1 second (when enabled)	
	SYNC	Synchronizes energy delivery to patient's QRS complex	
	FREEZE	Momentarily halts ECG trace on the cardioscope	
ECG Output	Unmodulated	1V/mV into 100Ω and 5000pF, multiplied by ECG SIZE selection (same frequency response as recorder)	
	Modulated	1400Hz ±2% center frequency, 1 ±0.1 Vrms	
	Frequency response	Matches strip chart recorder	
Defibrillator	Waveform	5msec monophasic pulse (Edmark) per AAMI specification	
	Energy Selection	0 joules (disarm), 5, 10, 20, 50, 100, 200, 300, 360 joules	
	Charge Time	360 joules in less than 12 seconds above 0°C (32°F)	
	Energy Accuracy	±10% for 50Ω load at 10° to 40°C (50° to 104°F) ±15% for 50Ω load at -10° to 55°C (14° to 131°F)	
	Energy Meter Accuracy	±5%	
	Paddle Area	Adult: 82cm^2 Pediatric: 16cm^2	
	Coil Cord Length	2.3m (7.5 ft)	
	Synchronizer	Energy discharge within 20msec of sync marker on cardioscope (triggers to patient-generated R wave)	
	Paddle Controls	Both paddles: energy discharge buttons (one on each paddle) STERNUM: ENERGY select dial rotates to select 0 to 360 joules APEX: CHARGE (with indicator light) initiates charging RECORD activates strip chart recorder	
Noninvasive Pacemaker (optional)	Output Rate	40 to 170 bpm	
	Rate Accuracy	±1.5% over entire range	
	Output Waveform	Monophasic, truncated, exponential current pulse with 20 ±5% droop measured at output current pulse ≥50mA peak at 20° ±5°C; pulse width is 20 ±1ms measured at output current pulse ≥10mA.	
	Output Current	0 to 200mA ±5% or 5mA (whichever is greater) at 700Ω output variation < 5% over a load range of 100 to 1500Ω	
	Refractory Period	Pacing rates	Refractory period
		40-90	340msec ±3%
		100	300msec ±3%
		110-120	250msec ±3%
		130-140	220msec ±3%
		150-170	200msec ±3%

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Table 1-1 LIFEPAK 10 defibrillator/monitor/pacemaker General Specifications *(continued)*

Environmental	Temperature	Standby: 5 to 55°C (41 to 131°F)
		Operating: −10 to 55°C (14 to 131°F) after minimum 2-hour storage at standby temperature
		Storage (without batteries): −30 to 65°C (−22 to 149°F)
	Humidity	0 to 95% (non-condensing), 0 to 34°C (32 to 93.2°F)
		0 to 80% (non-condensing), 35 to 55°C (95 to 131°F)
	Atmospheric Pressure	797 to 439mmHg (−570 to +15,000 ft)
	Vibration	Helicopter Aircraft: MIL-STD-810D, method 514.3 (category 6). Test levels per US Army Aeromedical Research Laboratory Report no. 91-14, section 2.6.3 (March 1991), (UH-1 helicopter, floor under co-pilot's seat).
		Fixed-Wing, Turboprop Transport: (take off and climb). Test level of 0.0016g^2/Hz, the maximum level per figure 32(31) of ECRI Report, contract no. 223-77-5035, prepared for FDA (April 1979).
	Shock (Drop)	With carrying case (soft case), passes drops of 43 inches from the handle (30 inches from case). This exceeds test levels per ECRI report, contract no. 223-77-5035, prepared for FDA (April 1979).
	Sealed Case	MIL-STD-108E and IEC 601-2-4
Battery		3 NiCad batteries, 12V, 1.0 amp hours each. A single new battery registering at least 100% capacity on the Battery Support System will provide at a minimum: • 45 minutes of monitoring, or • 30 minutes of pacing, or • 25 discharges at 360 joules per battery
Size	Height	10.4cm (4.0in)
	Width	40.6cm (16in)
	Depth	37cm (14.6in)
	Weight	9kg (20lbs)

All specifications at 25°C unless otherwise stated.

⚠ CAUTION

Possible equipment damage. To help prevent component damage, the device should not be mounted near vibration sources such as engine struts and landing gear.

Functional Description

The overall function of the LIFEPAK 10 defibrillator/monitor/pacemaker is shown in Figure 1-2 (the CRT Printed Flex Circuit is not shown). The device includes eight mechanical assemblies, listed in Table 1-2:

Table 1-2 LIFEPAK 10 mechanical assemblies

Assembly	Function
Main Control Panel Assembly Pacer Control Panel Assembly	Receives operator input
Paddle Assembly Relay Assembly	Delivers defibrillation energy
Recorder Assembly Status Display Module CRT Assembly CRT Printed Flex Circuit	Displays information to the operator

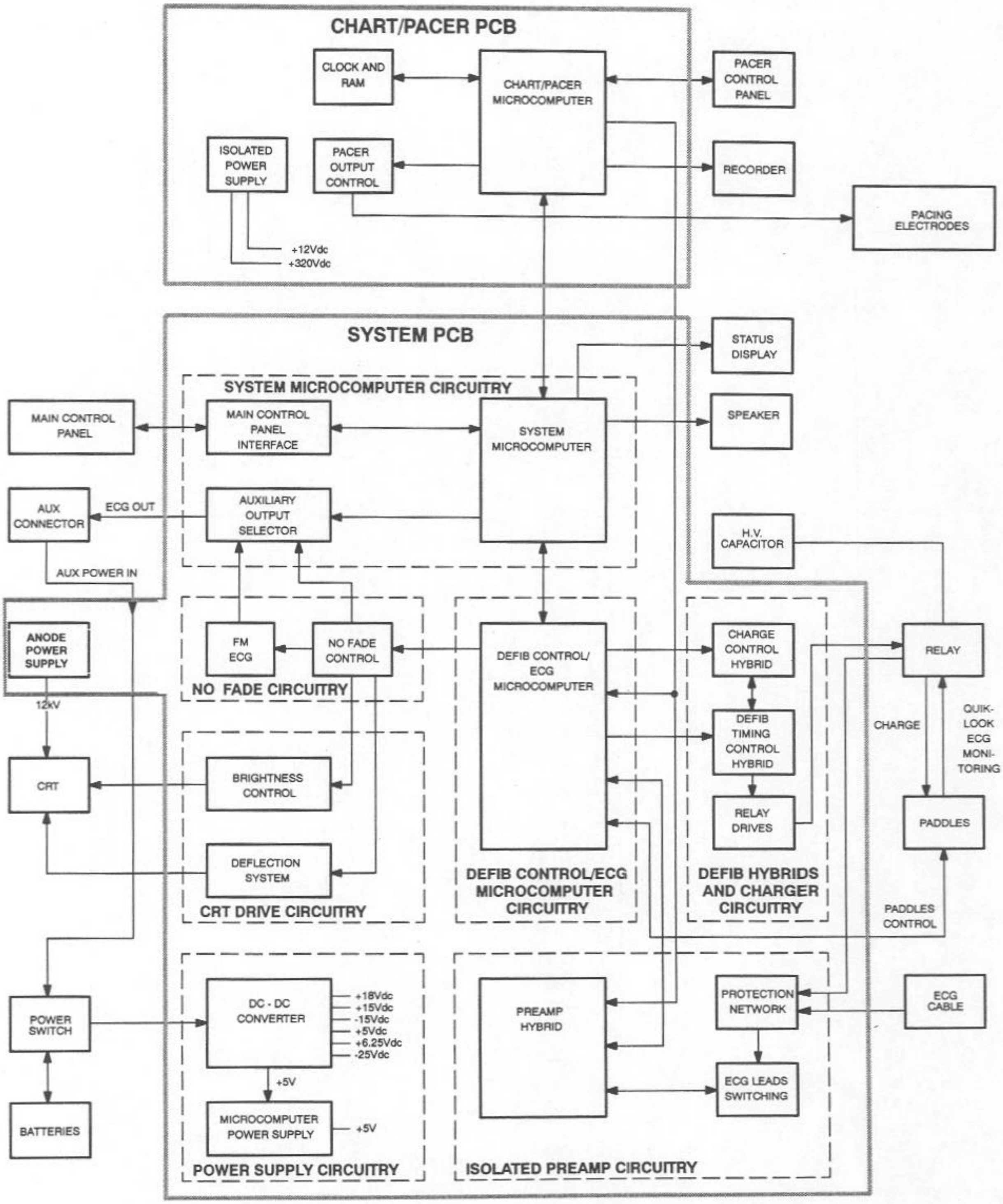
CHART/PACER PCB
CLOCK AND RAM
CHART/PACER MICROCOMPUTER
PACER CONTROL PANEL
ISOLATED POWER SUPPLY
PACER OUTPUT CONTROL
RECORDER
PACING ELECTRODES
+12Vdc
+320Vdc
SYSTEM PCB
STATUS DISPLAY
SYSTEM MICROCOMPUTER CIRCUITRY
MAIN CONTROL PANEL
MAIN CONTROL PANEL INTERFACE
SYSTEM MICROCOMPUTER
SPEAKER
AUX CONNECTOR
ECG OUT
AUXILIARY OUTPUT SELECTOR
H.V. CAPACITOR
AUX POWER IN
ANODE POWER SUPPLY
FM ECG
NO FADE CONTROL
NO FADE CIRCUITRY
DEFIB CONTROL/ ECG MICROCOMPUTER
CHARGE CONTROL HYBRID
RELAY
12kV
DEFIB TIMING CONTROL HYBRID
CHARGE
QUIK-LOOK ECG MONI-TORING
CRT
BRIGHTNESS CONTROL
RELAY DRIVES
PADDLES
DEFLECTION SYSTEM
CRT DRIVE CIRCUITRY
DEFIB CONTROL/ECG MICROCOMPUTER CIRCUITRY
DEFIB HYBRIDS AND CHARGER CIRCUITRY
PADDLES CONTROL
DC - DC CONVERTER
+18Vdc
+15Vdc
-15Vdc
+5Vdc
+6.25Vdc
-25Vdc
PREAMP HYBRID
PROTECTION NETWORK
ECG CABLE
POWER SWITCH
+5V
ECG LEADS SWITCHING
MICROCOMPUTER POWER SUPPLY
+5V
BATTERIES
POWER SUPPLY CIRCUITRY
ISOLATED PREAMP CIRCUITRY

Figure 1-2 LIFEPAK 10 defibrillator/monitor/pacemaker Functional Block Diagram

The device contains four or five of the PCB assemblies identified below. The following paragraphs briefly describe the PCB assemblies and the FAST-PATCH Adapter Assembly in this order:

- The System PCB Assembly
- The Anode Power Supply
- The Chart/Pacer PCB Assembly
- The optional MIEMSS (Maryland Institute of Emergency Medical Services Systems) Modulator PCB (not shown in Figure 1-2)
- The Energy Select PCB Assembly (not shown in Figure 1-2)

The System PCB Assembly controls all of the defibrillation and monitoring functions that include the operator interface, ECG signal processing, and defibrillation charging and delivery. As shown in Figure 1-2, the System PCB Assembly consists of seven subcircuits:

- Isolated Preamp Circuitry
- System Microcomputer Circuitry
- Defib Control/ECG Microcomputer Circuitry
- Defib Hybrids and Charger Circuitry
- No Fade Circuitry
- CRT Drive Circuitry
- Power Supply Circuitry

Two of the System PCB Assembly subcircuits employ 8-bit microcomputers with 16 kilobytes (KB) of internal programmable ROM (PROM): the System Microcomputer Circuitry, and the Defib Control/ECG Microcomputer Circuitry. Using instruction from the internal PROM, the System Microcomputer directs the overall function of the whole device and the interface with the Main Control Panel Assembly, the Status Display Module, and other device microcomputers. The Defib Control/ECG Microcomputer directs the defibrillation charging and delivery, and the ECG signal processing and information output. The other System PCB Assembly subcircuits are discussed below as they relate to other circuitry and are described in detail in the Theory of Operation.

The Chart/Pacer PCB Assembly controls the pacing and recorder functions. The design of the Chart/Pacer PCB Assembly is based on the same type of 8-bit microcomputer as used on the System PCB Assembly. The Chart/Pacer Microcomputer controls the interface with the Pacer Control Assembly and the output to the pacing electrodes (QUIK-PACE®) and the Recorder Assembly.

The Anode Power Supply converts the +15Vdc and −15Vdc supplied by the Power Supply Circuitry on the System PCB Assembly to the +12kVdc needed to operate the CRT Assembly. The Energy Select PCB Assembly (located within the Sternum Paddle Assembly and not shown in Figure 1-2) allows the operator to select one of eight discrete energy levels for defibrillation discharge. The Defib Control/ECG Microcomputer Circuitry decodes the energy selection information on the System PCB Assembly. When the optional MIEMSS Modulator PCB Assembly is installed, a jack on the upper case provides simultaneous output of three ECG signals: two are frequency modulated and one is unmodulated. (The Anode Power Supply and the Energy Select PCB are non-repairable assemblies.)

Any one of three rechargeable 12V/1.0A-hour NiCad batteries or an optional 120Vac, 220Vac, or 12Vdc Auxiliary Power Supply Module provides power for the device. The Auxiliary Power Supply Module supplies operating power while also trickle-charging any of the batteries installed in the device. The operator selects the power source by setting the five-position rotary POWER switch. The Power Supply Circuitry on the System PCB Assembly converts the +12Vdc input power to the dc voltage levels required. The Power Supply Circuitry also supplies +15Vdc and -15Vdc to the Anode Power Supply that supplies the +12kVdc to the CRT Assembly.

ECG signals are received from the patient through the three-lead ECG cable, the defibrillator paddles, or the FAST-PATCH electrodes. The Isolated Preamplifier Circuitry on the System PCB Assembly isolates, filters, and converts the ECG signal from analog to digital. The Defib Control/ECG Microcomputer analyzes the ECG signal for QRS detection. The signal is then passed to the No Fade Circuitry and CRT Drive Circuitry for display on the CRT Assembly and for output of a frequency-modulated or unmodulated ECG signal at the AUX connector.

The Defib Control/ECG Microcomputer regulates the output of the defibrillation pulses in response to operator input received through the defibrillator paddles. When the operator presses the CHARGE button on the APEX Paddle Assembly, the Defib Control/ECG Microcomputer instructs the Defib Hybrids and Charger Circuitry to charge the High Voltage Capacitor to the level indicated by the ENERGY rotary switch on the STERNUM Paddle Assembly. When the operator simultaneously presses both of the discharge buttons on paddles, the Defib Control/ECG Microcomputer instructs the Defib Hybrids and Charger Circuitry to discharge the pulse through the paddles.

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Theory of Operation

The following paragraphs provide detailed circuit descriptions of the System PCB Assembly, the Anode Power Supply, the Chart/Pacer PCB Assembly, and the optional MIEMSS Modulator PCB Assembly. Block diagrams of the PCB assemblies and many of the subcircuits are included in this section. Schematic diagrams are provided in Section 5; the diagrams can be referred to while reading the descriptions.

System PCB Assembly

The System PCB Assembly contains the circuitry that controls all of the defibrillation and monitoring functions for the defibrillator/monitor/pacemaker. As shown in Figure 1-2, the System PCB Assembly consists of seven subcircuits:

- Isolated Preamp Circuitry
- System Microcomputer Circuitry
- Defib Control/ECG Microcomputer Circuitry
- Defib Hybrids and Charger Circuitry
- No Fade Circuitry
- CRT Drive Circuitry
- Power Supply Circuitry

Isolated Preamp Circuitry

The Isolated Preamp Circuitry provides the initial ECG signal processing as well as leakage current isolation between the patient and the device. The ECG signal is obtained from the patient through the ECG cable, the defibrillation paddles using the QUIK-LOOK function, or the FAST-PATCH electrodes. The preamp amplifies the ECG signal from the patient by 750Hz, samples it at 600Hz, and converts the samples to precise pulse widths. The preamp then optically transmits the pulses across the Isolation Barrier to the Defib Control/ECG Microcomputer. The Isolated Preamplifier Circuitry consists of a Selection Relay, a Protection Network, an ECG Leads Switching circuit, the Preamp Hybrid, and an Isolation Barrier (see Figure 1-3).

Selection Relay. The Selection Relay K1 allows selection of ECG signal input from either the ECG patient cable or defibrillation paddles/FAST-PATCH electrodes. Depending on instruction from the Defib Control/ECG Microcomputer, the Preamp Hybrid U41 asserts the Lo Control signal high (+5V) or low. When Lo Control is low, the coil amplifiers Q21 and Q19 saturate thereby energizing the coil in K1 and selecting paddles. When Lo Control is high, Q19 and Q21 are off, coil is not energized, and the ECG cable is thereby selected.

To ensure low relay contact resistance, U39, U42, and their associated components provide relay contact current during switching intervals. When the Lo Control signal transitions from a low to a high, this high-going edge is capacitively coupled through C128 and CR37 to U39 pin 3.

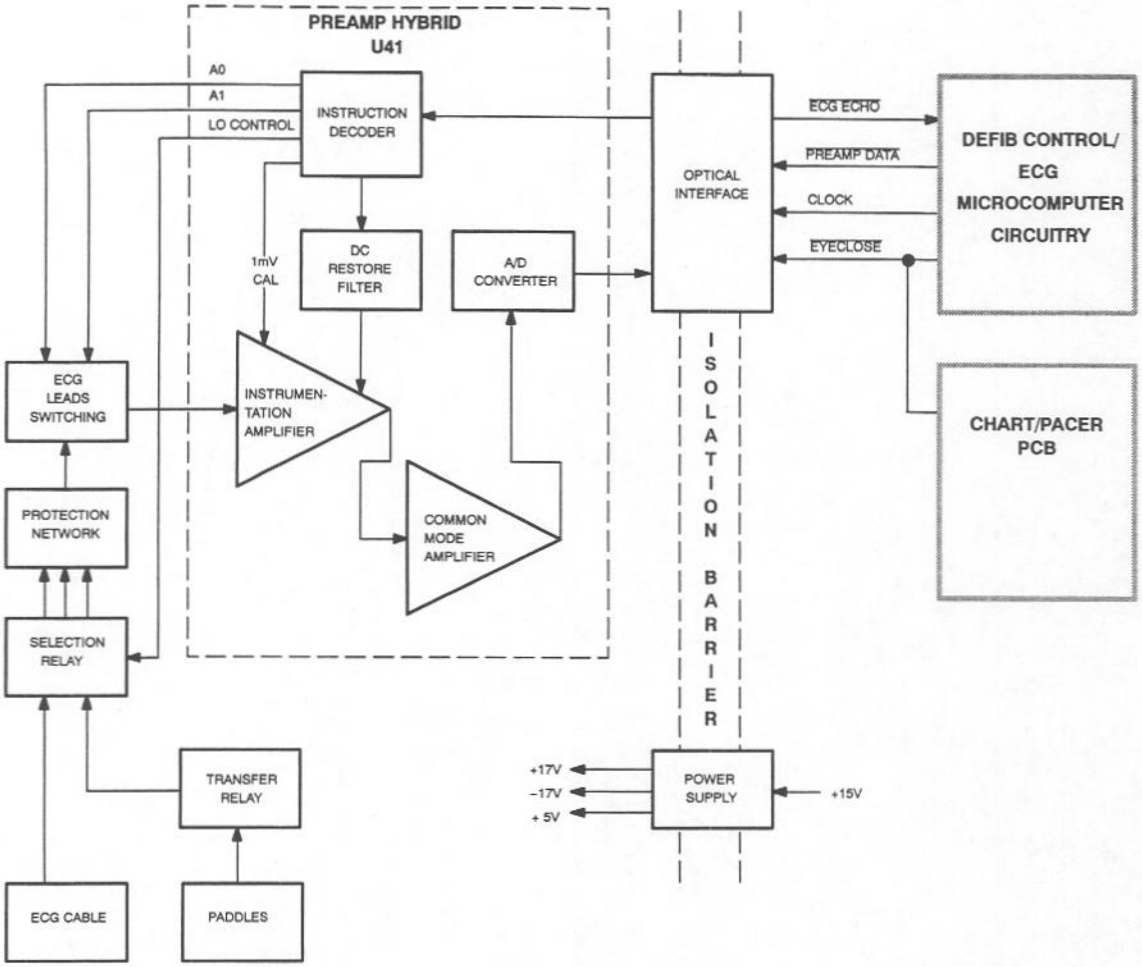

PREAMP HYBRID
U41
A0
A1
LO CONTROL
INSTRUCTION DECODER
DC RESTORE FILTER
1mV CAL
A/D CONVERTER
INSTRUMENTATION AMPLIFIER
COMMON MODE AMPLIFIER
ECG LEADS SWITCHING
PROTECTION NETWORK
SELECTION RELAY
TRANSFER RELAY
ECG CABLE
PADDLES
OPTICAL INTERFACE
ECG ECHO
PREAMP DATA
CLOCK
EYECLOSE
DEFIB CONTROL/ ECG MICROCOMPUTER CIRCUITRY
CHART/PACER PCB
ISOLATION BARRIER
POWER SUPPLY
+17V
−17V
+5V
+15V

Figure 1-3 Isolated Preamp Circuitry

When Lo Control transitions from a high to a low, this low-going edge is inverted by U39 pin 2, and coupled through C129 and CR36 to U39 pin 3. Diodes CR36 and CR37 pass the positive transitions to U39 pin 3 while isolating the negative transitions, thereby ensuring that U39 pin 3 always receives a high-going signal.

The long time constant of capacitors C128 and C129 and resistors R196 through 198 allows the voltage present at U39 pin 3 to remain at logic high for 250ms to 2sec. This results in a low output from U39 pin 4 for 250ms to 2sec when the relay switches. When U39 pin 4 is low, U42 pins 7 and 2 open, and U42 pins 10 and 15 close.

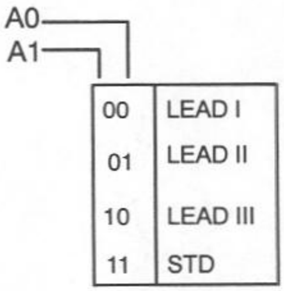
When U42 pins 7 and 2 open a grounded shunt on ac current sources R150 and R151 is removed. The R150 and R151 current sources are high value 200kΩ resistors driven by a 20kHz ac current from the isolated power supply transformer, T2. Shunting this current prevents extraneous noise from entering the preamplifier circuit during normal operation.

Closing switches at U42 (pins 10 and 15) couples this ac current through the analog multiplexers, U40, U43, and to the K1 relay contacts. The current passes into the patient cable where it is shunted to ground by the cable capacitance. The relay contacts momentarily switch about 80mA as the relay coil is energized or de-energized.

Protection Network. The Protection Network guards sensitive amplifier components within the Preamp Hybrid from damage during defibrillator discharges. The QUIK-LOOK contacts within the Transfer Relay provide additional isolation for the Apex and Sternum Paddle connections.

Primary protection is provided by gas-filled voltage surge protectors, VSP2 through VSP6. Secondary protection is provided by diode clamps to the supply rails. The Zener diode CR42 clamps the supply rails together. Third-level protection is provided by analog multiplexers U40 and U43. Relay K1 provides agency-mandated low voltage isolation between the ECG electrodes and the paddles.

ECG Leads Switching. The ECG Leads Switching circuit operates by multiplexing the Preamp Hybrid inputs (U41 pins 1 and 2) and reference drive output (U41 pin 5) to the appropriate ECG leads. Analog multiplexers U43 and U40 select the leads position by decoding the address appearing at A0 and A1 (U40/U43 pins 1 and 16). Refer to Figure 1-4 for the decoding information.



00	LEAD I
01	LEAD II
10	LEAD III
11	STD

Figure 1-4 ECG Leads Decoding Information

Preamp Hybrid. The Preamp Hybrid U41 consists of an instruction decoder, a dc restore filter, an anti-alias filter, an instrumentation amplifier, a common-mode amplifier, and an analog-to-digital (A/D) converter.

The Preamp Hybrid is controlled by a serial data stream from the Defib Control/ECG Microcomputer. The data is decoded by the instruction decoder that controls other circuit functions such as calibration and leads selection.

Because of interaction between software and the Preamp Hybrid, the Preamp Hybrid requires no external adjustments such as calibration of amplifier gain and offset. The precision resistor network RN14 eliminates the need for common-mode adjustment.

The anti-alias filter rejects unwanted high frequency components of the incoming analog ECG signal. The Instrumentation Amplifier amplifies the signal. The DC Restore Filter restores the ECG signal to center by nulling any dc offsets introduced when switching power sources or changing lead selections. The Common Mode Amplifier drives the signal to the average value of the ac common-mode voltage present at the ECG electrodes. The A/D converter converts the analog signal to a digital value that is presented to the Defib Control/ECG Microcomputer.

The Preamp Hybrid receives the $\overline{\text{Eyeclose}}$ signal from the Chart/Pacer Microcomputer during delivery of pacing pulses. This disconnects the Instrumentation Amplifier for 40ms to prevent the ECG signal from being distorted by detection of the pacing pulses.

Isolation Barrier. The Isolation Barrier electrically isolates the patient (connected through the ECG cable or defibrillator paddles) from the rest of the device circuitry. The incoming ECG signals and the outgoing data signals are optically transferred across the Isolation Barrier through opto-isolators U35 through U38. The relative timing of the Clock and Echo signals determines the ECG value. These signals are coupled with minimum transmission delay because delays translate to apparent dc offsets on the ECG signal.

The isolated power supply receives +15V from the main power supply and converts it to +5V, +17V and −17V. The pulse width modulator U30 drives the FET switches Q23 and Q24 which in turn drive the power transformer T2. The secondary transformer provides 17Vac which is rectified to provide unregulated power to the Preamp Hybrid. The unregulated +17Vdc is regulated to +5.00Vdc by U33. This regulated voltage provides the reference for the A/D converter in the Preamp Hybrid.

Section 2

Operation

Introduction

This section provides information about the basic operation of the LIFEPAK 10 defibrillator/monitor/pacemaker. It is not intended to instruct an operator in the clinical use of the device. For clinical use, refer to the separate *Operating Instructions* manual. This section includes the following information:

- Controls and Indicators
- Status Display Indicators and Messages
- Options Mode Selection and Programming
- Description of CODE SUMMARY™ critical event record
- Setting the Real-Time Clock

Controls, Indicators, and Connectors

Figure 2-1 and Table 2-1 provide information about the external features of the LIFEPAK 10 defibrillator/monitor/pacemaker including controls, indicators, and connectors.

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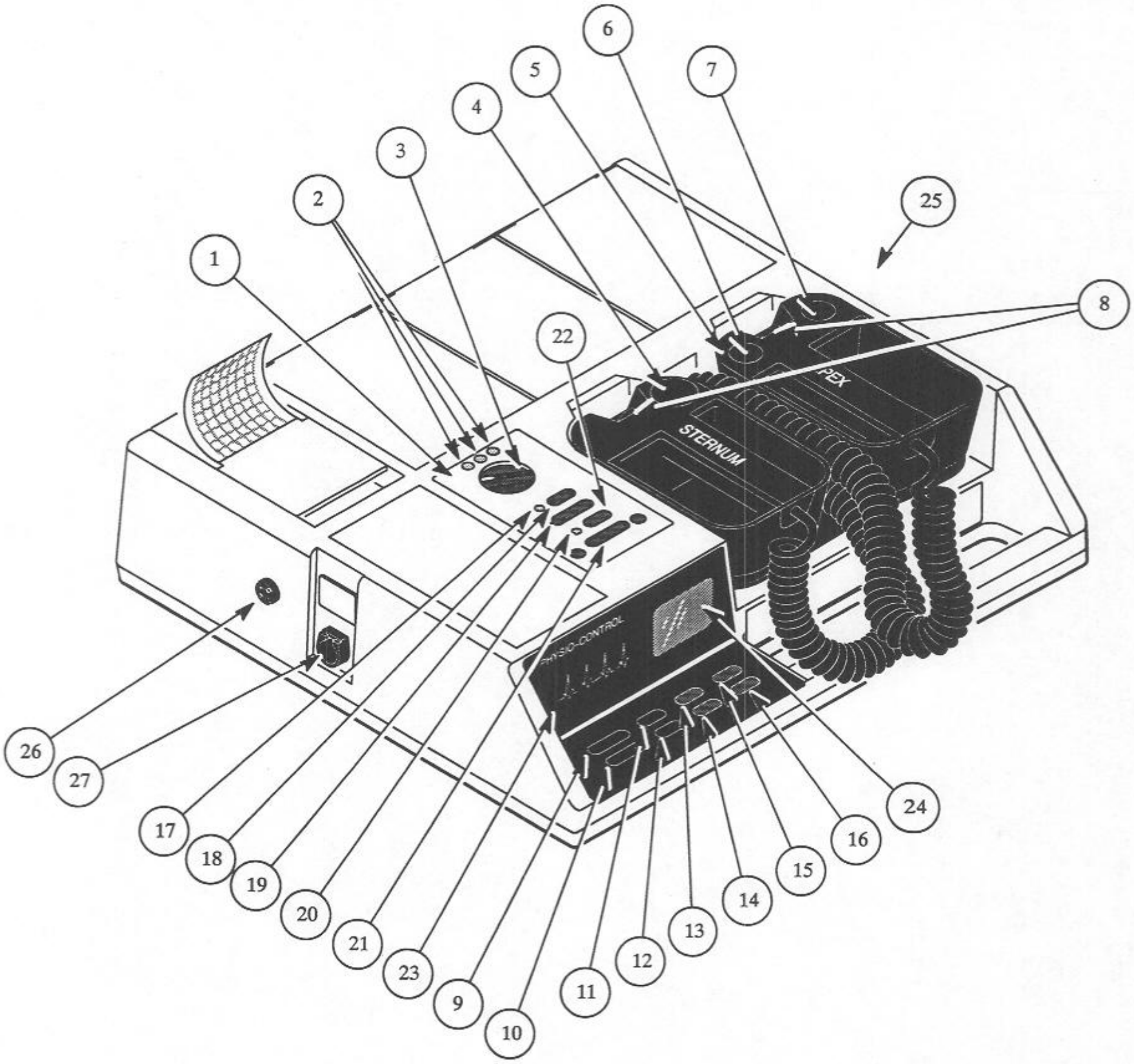
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26
27
STERNUM
APEX
PHYSIO-CONTROL

Figure 2-1 LIFEPAK 10 defibrillator/monitor/pacemaker Controls, Indicators, and Connectors

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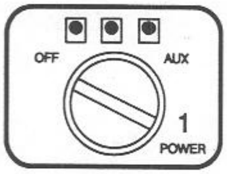
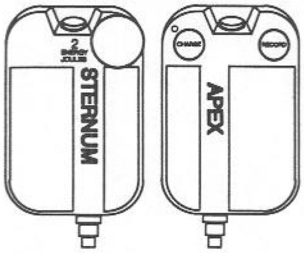
Table 2-1 LIFEPAK 10 defibrillator/monitor/pacemaker Controls, Indicators, and Connectors

Power:



1	OFF	Disconnects power from the device.
2	Battery 1, 2, 3	Rotating POWER to one of these battery indicators connects device circuitry to the battery installed in the corresponding compartment. Each battery has an associated LED that flashes at low battery or steadily illuminates to identify a depleted battery.
3	AUX	Allows device to draw operating power from Auxiliary Power Module (if connected).

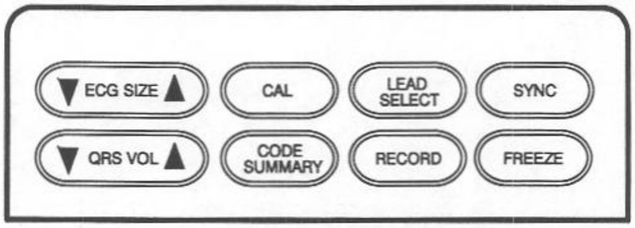
Paddles:



4	ENERGY JOULES	A rotary control to select one of the following energy ranges: 0J, 5J, 10J, 20J, 50J, 100J, 200J, 300J, and 360J. Rotating this switch internally discharges any available energy. The device cannot be charged when 0J is selected.
5	Charge Indicator (amber)	Illuminates when CHARGE is pressed. Flashes on and off as the defibrillator is charging. Glows steadily when selected charge is reached. Off at all other times.
6	CHARGE (amber)	Press to charge to the selected energy. Pressing this button also deactivates the pacemaker and resets pacing modes, if selected.
7	RECORD (grey)	This button functions identically to the RECORD button on the Main Control Panel (item 14 in this table). May be programmed for diagnostic frequency response (described on page 2-7, Options Mode Selection and Programming). When this feature is active, pressing and holding RECORD for one second selects the diagnostic mode and displays DIAG on the Status Display. The recorder prints a diagnostic quality ECG signal.
8	Discharge	Depress both discharge buttons (red color-US; black/amber- international) to discharge the device. During synchronized cardioversion, both buttons must remain pressed down until a QRS is detected.

Table 2-1 LIFEPAK 10 defibrillator/monitor/pacemaker Controls, Indicators, and Connectors *(continued)*

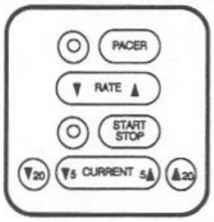
Main Control Panel:



9	▼ ECG SIZE ▲ (black)	Adjusts vertical size of ECG trace on the CRT and recorder. Size may be varied from 0.2cm/mV to 4cm/mV in 0.2cm/mV steps.
10	▼ QRS VOL ▲ (black)	Adjusts volume of QRS beeper.
11	CAL (black)	Simulates a 1mV calibration signal applied to the ECG leads. Inhibited during SYNC mode.
12	CODE SUMMARY (black)	Prints a summary of data for up to 50 critical events including defibrillation, pacing and ECG. Press once to start printing, press again to stop. Data is retained in memory for up to five minutes after device power is off.
13	LEAD SELECT (grey)	Selects type of lead for ECG input: Paddles, I, II, or III. Selecting Paddles suppresses the diagnostic mode but does not clear it.
14	RECORD (grey)	Toggles the recorder on and off. May be programmed for diagnostic frequency response. When this feature is active, pressing and holding RECORD for one second selects the diagnostic mode and displays DIAG on the Status Display. The recorder prints a diagnostic quality ECG signal. Press RECORD again to clear diagnostic mode and turn the recorder off.
15	SYNC (grey)	Toggles the device in and out of synchronized (SYNC) cardioversion mode. SYNC appears on Status Display when SYNC is selected. SYNC (QRS) marks are displayed as bright spots on the R wave. The device reverts to the SYNC-off state following a defibrillator discharge. SYNC is inhibited when the device is charged and both discharge buttons are pressed.
16	FREEZE (blue)	Freezes the ECG display on the CRT while pressed. If the recorder is running, it continues to print the delayed trace. Upon release of FREEZE, the recorder prints out the ECG waveform that had been frozen on the CRT.

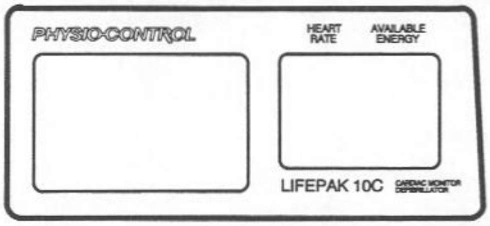
Table 2-1 LIFEPAK 10 defibrillator/monitor/pacemaker Controls, Indicators, and Connectors *(continued)*

Pacemaker Control Panel:



17	LED Indicator (green)	Indicates the pacemaker power is on.
18	PACER (grey)	Turns pacemaker power on or off. Allows user to confirm the QRS detection and adjust the ECG size without delivering current. At power-on the initial current and rate are set to minimum regardless of any previous settings.
19	▼ RATE ▲ (grey)	Increases or decreases pacing rate from 40 to 170bpm in 10bpm increments.
20	LED Indicator (green)	Indicates pacemaker current output is enabled. The LED blinks off for each pacing pulse actually delivered to the patient.
21	START/STOP (red)	Starts or stops pacing. The QUIK-COMBO electrodes must be attached to start pacing.
22	▼ CURRENT ▲ (grey)	Increases or decreases pacing current. Adjustable from 0 to 200mA in 5mA or 20mA increments.

Displays:



23	CRT DISPLAY (cardioscope)	Allows viewing of the ECG waveform and QRS (SYNC) marks (when in SYNC mode).
24	STATUS DISPLAY	Displays alphanumeric information about heart rate, available energy, lead selected, SYNC mode, DIAG mode, pacing current and rate, pacing electrode connection message (LEADS), and service indicator. Refer to Table 2-2 and Table 2-3 for a listing of information on this display.

External Connectors:

25	ECG Connector	Not shown, located on side of case next to paddles. Allows connection of 6-pin (3-lead) patient ECG cable for patient signal input.
26	MIEMSS Modulator Connector (optional)	Allows simultaneous output of two modulated and one unmodulated ECG signal.
27	AUX Connector	Allows either one of two connections: • Input power from AC or DC Auxiliary Power Module • Output of modulated or unmodulated ECG (1V/mV ECG) or QRS marks **Note:** For protection during shipping, a black plug is inserted into the AUX Connector. Be sure to remove and discard this black plug when unpacking and preparing the device for use.
28	Pacemaker Connector	Allows connection to the pacing cable.

Status Display Indicators and Messages

Table 2-2 lists and describes the indicators that may appear during the normal operation of the device. Table 2-3 lists operating messages and the circumstances when they appear.

Table 2-2 Status Display Indicators

<table>
<tr><th>Indicator</th><th>Function</th></tr>
<tr><td>SYNC</td><td>Indicates synchronized mode is enabled; blinks off with each detected QRS.</td></tr>
<tr><td>DIAG</td><td>Displays when diagnostic frequency response mode is enabled.</td></tr>
<tr><td>Service Indicator ⚠</td><td>Appears and remains on if any of the built-in tests encounters a possible failure. Indicates need for prompt service or repair if it remains on. May flash briefly after paddle discharge buttons are pressed.</td></tr>
<tr><td>Lead Selection Indicator</td><td>Indicates which one of four leads is selected: Paddles, I, II, or III.</td></tr>
<tr><td>Pacemaker Current</td><td>Indicates the current dosage in mA that will be delivered into a 700Ω load.</td></tr>
<tr><td>HEART RATE Display</td><td>Displays two functions:
• Pacemaker off: displays measured heart rate; range is 20-295bpm; symbol "- - -" indicates heart rate is outside the range of 20-295bpm
• Pacemaker on: displays selected (not measured) pacing rate from pacemaker control panel; range is 40-170bpm</td></tr>
<tr><td>AVAILABLE ENERGY</td><td>• Pacemaker off: displays available defibrillator energy (0-360J); displays 0 if device is not charging; number updates every second during charging
• Pacemaker on: displays selected pacing current (0-200mA)</td></tr>
<tr><td>Display Translations</td><td><table>
<tr><th>English</th><th>French</th><th>German</th><th>Spanish</th></tr>
<tr><td>LEADS</td><td>DERIVATION</td><td>ABLEITUNGEN</td><td>DERIVACIONES</td></tr>
<tr><td>SYNC</td><td>SYNC</td><td>SYNC</td><td>SINC</td></tr>
<tr><td>SET</td><td>REGL</td><td>EING</td><td>AJUS</td></tr>
<tr><td>mA</td><td>mA</td><td>mA</td><td>mA</td></tr>
<tr><td>DIAG</td><td>DIAG</td><td>DIAG</td><td>DIAG</td></tr>
</table></td></tr>
</table>

Table 2-3 Status Display Messages

Description	Displayed Message	Notes
Power-on	(ALL SEGMENTS)	All LCD segments are displayed
Normal Operation (Heart rate=60)	**60 0** J (LEAD)	
Defib charging	**- - - 123** J (LEAD)	
Defib ready (360J)	**- - - 360** J (LEAD)	
Attempt to activate pacemaker while paddles in use	**60 0** LEADS J (PADDLES)	LEADS annunciator flashes 3 times
Pacemaker on (rate = 80)	**080**SET **0** mA (LEAD)	
Pacemaker electrode disconnected while pacemaker started	**080**SET **0** LEADS mA (LEAD)	LEADS annunciator flashes 3 times
Recorder and CRT diagnostic mode	**- - - 0** J (LEAD) DIAG	

Options Mode Selection and Programming

The options mode allows access to configuration, calibration, and diagnostic failure code information stored in EEROM. Figure 2-2 provides a step-by-step flow chart to aid when a technician is accessing the options mode. Table 2-4 lists and defines the various options modes o01 through o11. Table 2-5 defines the initial options mode selections when the device is shipped from the factory.

To activate the options mode, first rotate the POWER switch to OFF. Install a battery in position 1. Then insert the programming key into the AUX connector, rotate the POWER switch to the battery 1 position, and remove the programming key.

Confirm that o01 appears on the Status Display indicating entry into the options mode.

- Pressing ▼ ECG SIZE ▲ changes the option numbers
- Pressing ▼ QRS VOL ▲ changes the status of the option number
- Pressing CAL enters the selection into memory (a beep sounds confirming the selection is entered)
- Pressing FREEZE changes from options mode to other types of data

To exit the options mode, wait at least one full second after pressing CAL to allow sufficient time for the changes to be stored in memory, then rotate the POWER switch to OFF.

⚠ CAUTION

Possible corruption of defibrillator constants and options settings. When changing status selections or values in the options mode, after pressing CAL to enter the new value wait at least **one full second** before rotating the POWER switch to OFF to allow the System PCB microprocessor sufficient time to properly store the changes. If power is removed in less than one second, the EEROM memory contents may be corrupted, including the defibrillator calibration constants and the options mode status selections. If the EEROM memory contents are corrupted, the device will display the service indicator symbol indicating a failure code has been recorded. To investigate the failure, refer to Figure 2-2 (page 2-9) and Status Display Failure Codes (page 3-36). To restore the correct EEROM memory contents, reselect the proper options mode status selections and perform the Test and Calibration Procedures (TCP) for TCP-Defibrillator Calibration, TCP-AVAILABLE ENERGY Display, and TCP-Recorder Calibration (beginning on page 3-24).

Note: Because the options mode settings are stored in EEROM, if the System PCB is replaced, (which contains the EEROM) the current options mode settings are lost. Before removing a System PCB for replacement, be sure to enter the options mode and write down the current options mode settings. After installing the new System PCB, be sure to enter the options mode and reenter these recorded settings. If the user's settings are not available, the original factory settings are listed in Table 2-5 on page 2-11.

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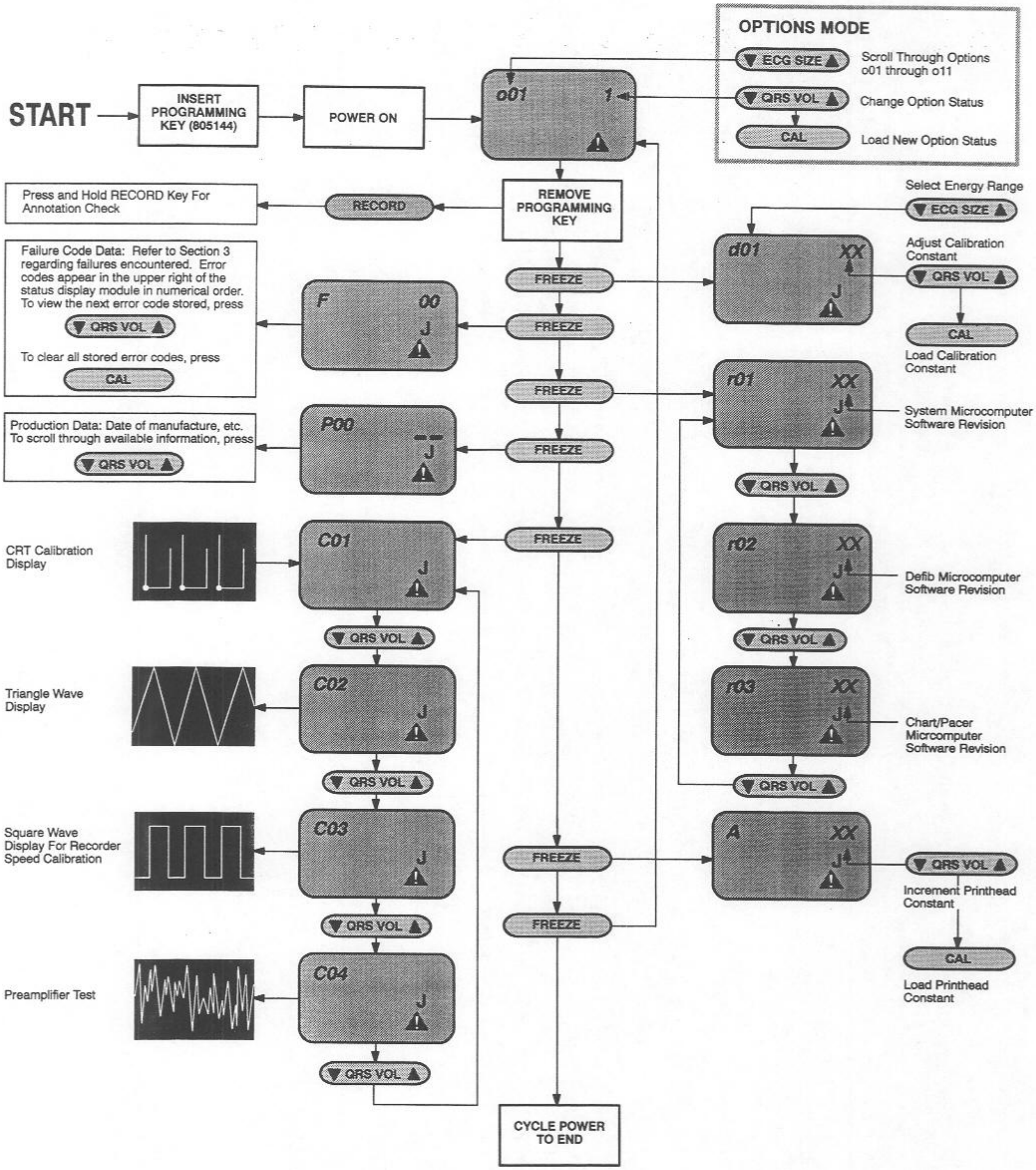
OPTIONS MODE
ECG SIZE
Scroll Through Options o01 through o11
QRS VOL
Change Option Status
CAL
Load New Option Status
START
INSERT PROGRAMMING KEY (805144)
POWER ON
o01 1
REMOVE PROGRAMMING KEY
RECORD
Press and Hold RECORD Key For Annotation Check
FREEZE
Failure Code Data: Refer to Section 3 regarding failures encountered. Error codes appear in the upper right of the status display module in numerical order. To view the next error code stored, press
QRS VOL
To clear all stored error codes, press
CAL
F 00 J
Production Data: Date of manufacture, etc. To scroll through available information, press
QRS VOL
P00 -- J
CRT Calibration Display
C01 J
Triangle Wave Display
C02 J
Square Wave Display For Recorder Speed Calibration
C03 J
Preamplifier Test
C04 J
QRS VOL
CYCLE POWER TO END
Select Energy Range
ECG SIZE
d01 XX J
Adjust Calibration Constant
QRS VOL
CAL
Load Calibration Constant
r01 XX J
System Microcomputer Software Revision
r02 XX J
Defib Microcomputer Software Revision
r03 XX J
Chart/Pacer Microcomputer Software Revision
A XX J
Increment Printhead Constant
Load Printhead Constant

Figure 2-2 Options Mode Selection Flow Chart

Table 2-4 Description of Options Mode Selections

Option Number	Description	Status Selection
o01	Allows recorder to be placed in diagnostic mode.	0 = no 1 = yes
o02	If yes, the energy charge level is displayed on the Status Display.	0 = no 1 = yes
o03	If yes, the service/failure symbol will be displayed on the LCD for some failure conditions.	0 = no 1 = yes
o04	Determines the frequency response specifications for the cardioscope and recorder (See Table 1-1 on page 1-4).	0 = agency 1 = domestic
o05	(Not implemented)	(not applicable)
o06	Defines the maximum pacing rate available.	0 = 170 1 = 140
o07	Selects the language displayed on the Status Display.	0 = English 1 = French 2 = German 3 = Spanish
o08	Determines the lead selected when the device powers on.	0 = lead II 1 = paddles
o09	Determines the line power notch filter frequency.	0 = 50Hz 1 = 60Hz
o10	Determines the type of signal available at the AUX connector.	1 = ECG 2 = Modulated ECG 3 = QRS 4 = Serial data
o11	Enables the notch filter on the ECG leads for diagnostic frequency response. (The notch filter is not needed and not available on the ECG leads for monitor frequency response; the notch filter is always enabled in paddles.)	0 = no 1 = yes

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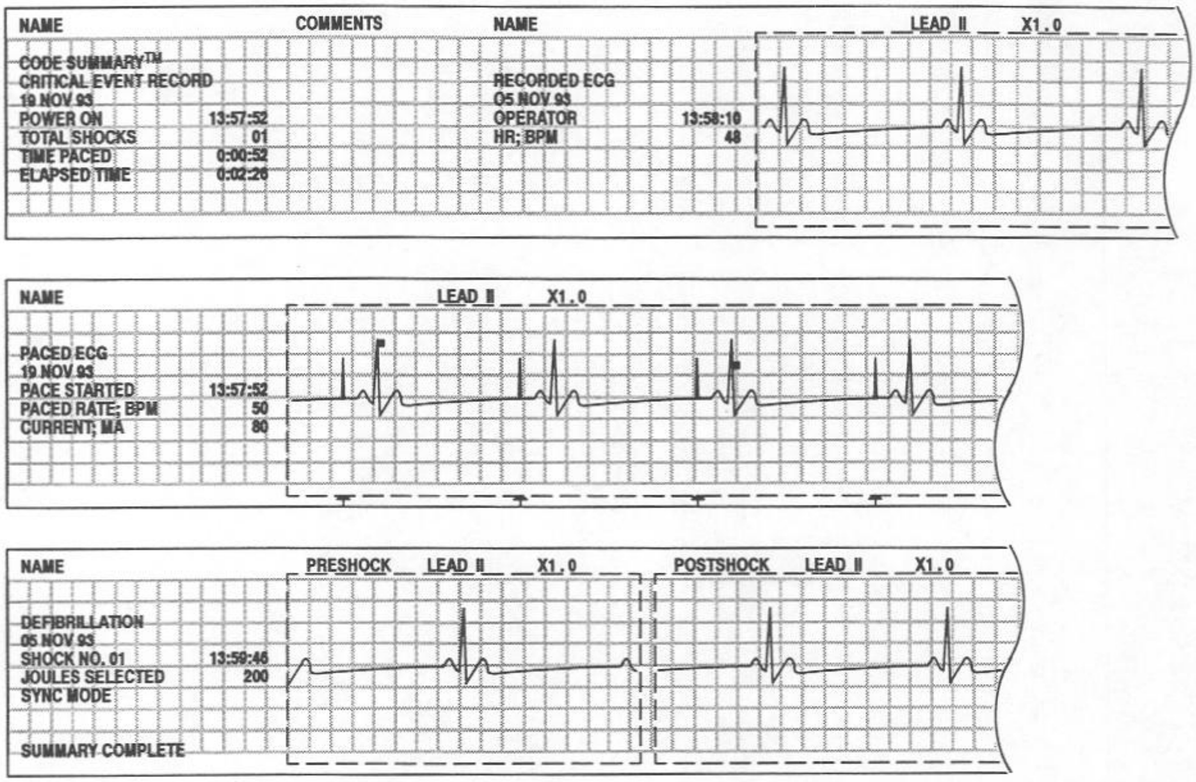
Table 2-5 Factory Settings for Options Mode Selections

Dash Number (804200-xx)	Option Number										
	o01	o02	o03	o04	o05	o06	o07	o08	o09	o10	o11
-00, 14, 28, 66	0	1	1	1	1	0	0	0	1	1	0
-01, 15, 29	0	1	1	1	1	0	2	0	0	1	0
-02, 16, 30	0	1	1	0	1	0	1	0	0	1	0
-03, 17, 31	0	1	1	1	1	0	3	0	0	1	0
-04, 18, 32, 45	0	1	1	1	1	0	0	0	0	1	0
-05, 19 33	0	1	1	1	1	0	0	0	1	1	0
-06, 20, 34	0	1	1	1	1	0	2	0	0	1	0
-07, 21, 35	0	1	1	0	1	0	1	0	0	1	0
-08, 22, 36	0	1	1	1	1	0	3	0	0	1	0
-09, 23, 37, 44, 46	0	1	1	1	1	0	0	0	0	1	0
-10, 24, 38	0	1	1	1	1	0	0	0	1	1	0
-11, 25, 39	0	1	1	1	1	0	0	0	1	1	0
-12, 26, 40	0	1	1	1	1	0	1	0	1	1	0
-13, 27, 41	0	1	1	1	1	0	1	0	1	1	0
-47, 59	0	1	1	1	1	0	0	0	1	1	0
-43, 62	0	1	1	1	1	0	0	0	1	1	0
-42, 63	0	1	1	1	1	0	0	0	1	1	0

CODE SUMMARY Record

The CODE SUMMARY critical event record provides a printed record of details about critical events including defibrillation, pacing, and ECG monitoring. Memory for the CODE SUMMARY record consists of 32KB of RAM. The recording of CODE SUMMARY events in memory is initiated whenever the operator initiates defibrillation, activates pacing, or activates the recorder. The CODE SUMMARY information is printed out when the operator presses the CODE SUMMARY button. An internal battery maintains power to the RAM to retain the CODE SUMMARY information for up to five minutes after the POWER switch is turned to OFF. After five minutes without power, CODE SUMMARY information is erased. Printing the CODE SUMMARY report does not affect the CODE SUMMARY information in memory. The CODE SUMMARY information can only be deleted by removing power from the device for more than five minutes.

The LIFEPAK 10 defibrillator/monitor/pacemaker can store information for a maximum of 50 CODE SUMMARY events. Examples of event information are shown in Figure 2-3. Information may include two parts: a "preamble" and the ECG trace. The preamble consists of the time, date, and event parameters. The ECG trace consists of ECG information and event parameters.


NAME COMMENTS NAME LEAD II X1.0

CODE SUMMARY™
CRITICAL EVENT RECORD
19 NOV 93
POWER ON 13:57:52
TOTAL SHOCKS 01
TIME PACED 0:00:52
ELAPSED TIME 0:02:26

RECORDED ECG
05 NOV 93
OPERATOR 13:58:10
HR; BPM 48

NAME LEAD II X1.0

PACED ECG
19 NOV 93
PACE STARTED 13:57:52
PACED RATE; BPM 50
CURRENT; MA 80

NAME PRESHOCK LEAD II X1.0 POSTSHOCK LEAD II X1.0

DEFIBRILLATION
05 NOV 93
SHOCK NO. 01 13:59:46
JOULES SELECTED 200
SYNC MODE

SUMMARY COMPLETE

Figure 2-3 Sample Printout of the CODE SUMMARY Record

For a Record Event, the ECG trace includes six seconds of ECG: three seconds before and after the RECORD button is pressed to activate the recorder. For a Pacing Event, the ECG trace includes six seconds of ECG *after* pacing is activated and controls remain unchanged for ten seconds. For a Defibrillation Event, the ECG trace is blanked for three seconds immediately following the shock; the ECG trace is comprised of the ECG three seconds previous to the shock, and five and one-half seconds following the three-second blanking period.

Events are stored in chronological order as they occur. All 50 events include preamble information, but because of memory limitations, only 22 of the events can also include the ECG trace. After the first 22 events are stored, subsequent events are stored according to the following priority:

Priority 1: Defibrillation Events
Priority 2: Pacing Events
Priority 3: Recorder Events

The storage of CODE SUMMARY information is summarized in Table 2-6. After 22 events are stored, subsequent higher-priority events may record the ECG trace over previously recorded lower-priority events. In general, the last event recorded includes both preamble and ECG trace.

Table 2-6 CODE SUMMARY Information Stored in Memory

Event	Recorder Event	Pacing Event	Defibrillation Event
1-22	Preamble + ECG.	Preamble + pacing/ECG.	Preamble + defib/ECG.
23-50	Stores preamble only (no ECG) except for last event (see below).	Stores preamble. Also looks for a lower priority Recorder Event X between 1-22. If found, also stores pacing/ECG causing Event X to retain only preamble. (For last event, see below.)	Stores preamble. Also looks for a lower priority Recorder or Pacing Event X between 1-22. If found, also stores defib/ECG causing Event X to retain only preamble. (For last event, see below.)
51+	No preamble or ECG except for last event (see below).	No preamble or ECG except for last event (see below).	No preamble or ECG except for last event (see below).
Last Event	Stores preamble. If there exist fewer than 22 previous Pacing or Defib Events, also stores ECG.	Stores preamble. If there exist fewer than 22 previous Defib Events, also stores pacing/ECG.	Stores preamble and defib/ECG data.

The time of day of printing is printed on the border of the recorder paper. The time information is also printed as part of the CODE SUMMARY information. The supply voltage level is monitored to protect the RTC and RAM data if battery voltage falls too low.

Setting the Real-Time Clock

Set the real-time clock to the current day, date, and time by performing the following steps:

1. Activate the clock-set mode by pressing and holding RECORD on the APEX paddle while rotating the POWER switch from OFF to the battery 1 position. The numbers flashing in the Status Display heart rate field are the hours digits of the 24-hour clock.
2. To set the hours, press the ▼ QRS VOL ▲ button until the desired value (1-24) is displayed.
3. To set the minutes, press (▲) on the ECG SIZE button until the digits in the available energy field of the Status Display begin to flash. Press (▲) on the QRS VOL until the desired minutes value (1-59) is displayed.
4. To set the month, press (▲) on the ECG SIZE button until the digits in the heart rate field of the Status Display begin to flash. Press ▼ QRS VOL ▲ until the desired month (1-12) is displayed.
5. To set the day, press (▲) on the ECG SIZE button until the digits in the available energy field of the Status Display begin to flash. Press ▼ QRS VOL ▲ until the desired day (1-31) is displayed.

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6 To set the year, press (▲) on the ECG SIZE button until the digits in the heart rate field of the Status Display begin to flash (in this mode, the available energy field is blank). Press ▼ QRS VOL ▲ until the desired year (00-99) is displayed.

Note: The year 2000 is displayed as 00, 2001 is displayed as 01, etc.

7 To terminate the clock-set mode, rotate the POWER switch to OFF.

Confirm the proper clock setting by turning device power on and pressing RECORD after the self-test is complete. The printed strip should confirm the proper time and date.

Section 3

Testing and Troubleshooting

Introduction

This section describes how to test, calibrate, and troubleshoot the LIFEPAK 10 defibrillator/monitor/pacemaker. Topics cover:

- The Performance Inspection Procedure (PIP)
- The Test and Calibration Procedure (TCP)
- Troubleshooting Aids

Prefixes are used to distinguish testing steps.

- **PIP**—identifies Performance Inspection Procedure steps
- **TCP**—identifies Test and Calibration Procedure steps

Performance Inspection Procedure

This Performance Inspection Procedure (PIP) checks whether a LIFEPAK 10 defibrillator/monitor/pacemaker is functioning within specifications. Perform the PIP regularly as a periodic maintenance check and after any repair or calibration.

The device case does not need to be opened to perform the PIP. The PIP Checklist (page 3-17) may be photocopied and used to record the PIP results. If the device fails any part of the PIP, refer to the Test and Calibration Procedure (page 3-18) and the Troubleshooting Aids (page 3-32) for help in locating any failed subassemblies.

PIP-Scope and Applicability

This PIP applies to all LIFEPAK 10 defibrillator/monitor/pacemakers. This PIP does *not* apply to:

- LIFEPAK 10C defibrillator/monitor/pacemakers

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- AC or DC Auxiliary Power Module
- Battery Support System

Refer to their respective service manuals for testing information.

PIP-Definitions

Acronyms used in this procedure are:

bpm	Beats per minute
DMM	Digital Multimeter
ECG	Electrocardiogram
NSR	Normal Sinus Rhythm
PIP	Performance Inspection Procedure
p-p	Peak-to-peak
ppm	Pulses per minute
QRS or QRS Complex	Refers to portions of the ECG waveform
TCP	Test and Calibration Procedure

PIP-Requirements

The requirements for test equipment, workstation, and personnel are listed below along with important safety information.

PIP-Required Equipment

Performing this PIP requires the equipment listed in Table 3-1. Although specific test instruments are recommended, other test equipment with equivalent specifications may be used.

Table 3-1 PIP Test Equipment

Equipment	Specifications	Manufacturer
Defibrillator Energy Meter	Power Range: 0-400J Load Resistance: 50Ω ±10% Accuracy: ±3%	Bio-Tek QED-6 or equivalent*
ECG simulator	Accuracy: 1% of selected rate	Bio-Tek QED-6 or equivalent*
12-Lead ECG Patient Simulator**	Accuracy: 0.5% of selected rate Outputs: 12-lead ECG	Dynatech Nevada 215A, or equivalent*
Pacemaker Tester	Current/Voltage Accuracy: ±2% of reading Pulse Width Measurement Accuracy: ±0.5%	Bio-Tek QED-6 or equivalent*
Leakage Tester/ Safety Analyzer	Current Accuracy: ±1% Resistance Accuracy: ±1%	Dynatech Nevada 232, or equivalent*
Digital Multimeter (DMM)	3-1/2 digits Input Resistance: 10MΩ	Fluke Model 8010 or equivalent*
LIFEPAK 10 Programming Key		Physio-Control PN 805144 (provided with device)
AC Auxiliary Power Supply***	120/220Vac input. 12Vdc output	Physio-Control 804217
DC Auxiliary Power Supply***	12Vdc input. 12Vdc output	Physio-Control 804220
AC Auxiliary Power Module***	120/220Vac input. 12Vdc output	Physio-Control 806311
DC Auxiliary Power Module***	12Vdc input. 12Vdc output	Physio-Control 3005494
Timer	1 second resolution	

* Equivalent equipment is required to meet the specifications listed in the specifications column.

** Required only for testing the optional 12 lead ECG adapter.

*** Required if the device is ever used with this power supply/module.

PIP-Test Equipment Validation

All test equipment used in performing the PIP must have a current calibration label affixed to its exterior. The calibration label must be issued by a certified calibration facility.

PIP-Workstation

If ac line power is provided to this workstation it must be connected to a grounded power source.

PIP-Personnel

Personnel performing this PIP must be thoroughly familiar with the operation of the LIFEPAK 10 defibrillator/monitor/pacemaker. Personnel performing this PIP must meet one or more of the following levels of education or experience:

- Associate of applied science degree with a major emphasis in biomedical electronics
- Certificate of technical training in electronics with a major emphasis in biomedical electronics
- Equivalent biomedical electronics experience

⚠ WARNING

Shock hazard. When charged and discharged during this PIP, the LIFEPAK 10 defibrillator/monitor/pacemaker discharges up to 360J of electrical energy through the defibrillator paddles. This electrical energy must be safely discharged as described in this PIP. Do not attempt to perform this procedure unless you are thoroughly familiar with the operation of the LIFEPAK 10 defibrillator/monitor/pacemaker.

PIP-General Instructions

The PIP sections are intended to be performed in the order listed. After completing a section, do not change the equipment settings and connections unless instructed to do so.

⚠ CAUTION

Possible corruption of defibrillator constants and options settings. When changing status selections or values in the options mode, after pressing CAL to enter the new value wait at least **one full second** before rotating the POWER switch to OFF to allow the System PCB microprocessor sufficient time to properly store the changes. If power is removed in less than one second, the EEROM memory contents may be corrupted, including the defibrillator calibration constants and the options mode status selections. If the EEROM memory contents are corrupted, the device will display the service indicator symbol indicating a failure code has been recorded. To investigate the failure, refer to Table 2-4 (page 2-10) and Status Display Failure Codes (page 3-36). To restore the correct EEROM memory contents, reselect the proper options mode status selections and perform the Test and Calibration Procedures (TCP) for TCP-Defibrillator Calibration, TCP-AVAILABLE ENERGY Display, and TCP-Recorder Calibration (beginning on page 3-24).

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Note: To perform this PIP, you may need to change some of the user's current options mode settings as described in Table 2-4 (page 2-10). Before performing the PIP, enter the options mode and write down the current settings. After the PIP is completed, be sure to re-enter the options mode and restore the settings to their original values.

PIP-Physical Inspection

Perform the exterior physical inspection as described below:

- Inspect all exterior surfaces for signs of abuse or other damage, including fluid spills, cracks and dents.
- Inspect paddles for pitted electrode plates, presence of dried defibrillation gel, and integrity of cables and switches. Remove gel or other foreign matter from paddles.
- Inspect recorder for ease of door operation and positive latching. Remove dust or foreign matter inside recorder.
- With no batteries installed, cycle the POWER switch to confirm that the knob is tight on the shaft and the switch indexes properly. Return the switch to the OFF position.
- Inspect all external connections for bent, broken, or corroded pins, and debris.
- Press all buttons and check them for uniform feel.
- Inspect all cables and accessories for damage, cracks, breaks, bent or broken connector pins, or other signs of wear.
- Inspect the battery connector pins for wear and replace any pins which appear bent, broken, loose, corroded, worn, or damaged. For replacement information, refer to page 4-11.

PIP-Power-On Sequence

Install a FASTPAK battery in the battery 1 receptacle.

1. Connect the ECG simulator to the device (no power to the simulator). Turn on the device by rotating the POWER switch from OFF to the battery 1 position.
2. Confirm that the device powers up with the Lead II or Paddles lead as indicated on the lower left of the Status Display. The default lead configuration is a programmable selection. Refer to Options Mode Selection and Programming (page 2-7) for information about changing the default lead configuration.
3. Confirm that the display is backlit and clearly visible.
4. Confirm that the Status Display exhibits three dashes in the upper left corner and 0J in the upper right, and that all of the other annunciators are not displayed.

PIP-Fault Stack Check

Checking the Fault Stack allows access to the self-diagnostic feature of the LIFEPAK 10 defibrillator/monitor/pacemaker. If a failure occurs, the appropriate failure code(s) is (are) logged and a qualified service technician can read and record it. Table 3-11 (page 3-36) lists all of the possible failure codes and corresponding failures.

1 Rotate the POWER switch to OFF and insert the Programming Key into the AUX connector. Rotate POWER to battery 1 and remove the Programming Key. The device is now in the options mode.
2 Press the FREEZE button twice to scroll to the failure code data screen.
3 Write down a list of any displayed failure codes (press QRS VOL to sequentially display the numerical codes; any number other than 00 is a failure code). Retain this list of recorded failure codes for possible use if other failure codes are logged during this PIP and troubleshooting is required.
4 Press CAL to clear any failure codes.
5 Rotate the POWER switch to OFF to exit the options mode.

PIP-Paper-Out Sensor and Recorder Speed

Use the ECG simulator to input a 1mV, 60bpm NSR signal through the patient ECG cable. Make sure a roll of paper is installed in the recorder.

1 Turn on the device by rotating the POWER switch from OFF to the battery 1 position.
2 Confirm that an NSR waveform displays on the CRT.
3 Open the recorder door and press RECORD. Confirm that the recorder does not operate.
4 Close the recorder door. Press RECORD on the main control panel and confirm that the recorder prints the NSR waveform on the paper.
5 Check that the time and date on the printout are correct.
6 Press RECORD on the APEX paddle to turn off the recorder.
7 Confirm that the spacing between R wave peaks is 25 ± 1mm.

PIP-CODE SUMMARY

1 Charge the defibrillator to 100J.
2 Discharge the energy through the standard paddles into the external energy meter.
3 Press CODE SUMMARY.
4 Confirm the recorder prints a CODE SUMMARY report that indicates a 60 bpm heart rate from the recorder speed check and the defibrillator discharge (from step 2).

PIP-Freeze and ECG Audio Checks

Select Lead II and watch the display exhibit QRS complexes over the entire width of the ECG waveform.

1 Press QRS VOL (▲) repeatedly until you hear a beep. Then press and hold QRS VOL (▲) and confirm that the beep gets louder. Then press QRS VOL (▼) until the tone is inaudible.
2 Press RECORD to start the recorder.
3 After annotations are printed on the recorder, press FREEZE and confirm that the CRT waveform stops for as long as the button is held.

4 Release FREEZE and confirm that the recorder prints the ECG trace that was frozen on the display as indicated by the annotation at the bottom of the recorder paper.

5 Press RECORD to turn off the recorder.

6 Confirm that the correct time, lead setting, and heart rate is printed across the top of the strip and that an ECG wave form is printed across it.

PIP-Preamplifier Baseline Noise and CAL Pulse Checks

1 Disconnect the LL and RA patient cable leads from the ECG simulator (red and white leads for AHA cable, green and red leads for IEC cable). Press the LL and RA metal cable leads together so that they are electrically shorted.

2 Press LEAD SELECT (as necessary) to select Lead II. Press ECG SIZE (▲) four times.

3 Press RECORD to confirm that the selected ECG size is x1.8. Confirm that the recorder prints a trace with a thickness of less than 1mm. Press ECG SIZE (▼) four times so that ECG size is x1.0, then press RECORD to turn off the recorder.

4 Press and hold RECORD for more than 2 seconds to select DIAG (diagnostic) response.

Note: If DIAG does not appear in Status Display confirming diagnostic response, refer to Options Mode Selection and Programming, page 2-7, and reprogram the device to enable the diagnostic response.

5 Press CAL to confirm that the recorder prints a pulse that has a vertical leading edge of 10 ±1mm.

6 Press RECORD to turn the recorder off.

PIP-Heart Rate and Lead Polarity

1 Connect the patient ECG cable to the ECG simulator and select a 30bpm NSR signal.

2 Select Lead I and confirm that the displayed heart rate is between 27 and 33bpm.

3 Input a heart rate of 240bpm. After 15 seconds confirm that the displayed heart rate is between 233 and 247bpm.

4 Select Lead II and confirm that the signal polarity is the same as Lead I.

5 Select Lead III and confirm that the signal polarity is the same as Lead I.

PIP-Synchronized Cardioversion

Select Lead II, increase the QRS volume so that it is clearly audible, and change the ECG rate to 30bpm.

1 Press RECORD, then SYNC. Confirm that the QRS sense markers appear on the CRT with each QRS complex.

2 As the first marked complex moves off of the left side of the CRT display, confirm that it is printed on the recorder paper.

3 Press RECORD to turn the recorder off.

4 Confirm that the SYNC annunciator is visible on the Status Display, and that it blinks with each detected R wave.

5 Hold the paddles on the external energy meter.

6 Charge the defibrillator to 100J.

7 Wait for an interval between QRS complexes. Press and hold one discharge button for at least one QRS complex. Confirm that the defibrillator does not discharge.

8 Press and hold the other discharge button for at least one QRS complex. Confirm that the defibrillator does not discharge.

9 Press and hold both discharge buttons. Confirm that the defibrillator discharges when the next QRS complex occurs (the ECG signal on the CRT may stop momentarily). Release the buttons.

10 Confirm that the device exits the synchronized mode.

11 Store the paddles in the paddle wells.

PIP-Warm/Cold Restart Check

If the power switch is set to an empty battery receptacle for less than 30 seconds, the device returns to the same mode it was in before power was removed. This is defined as "warm restart." A "cold restart" is when the device *does not* return to the mode it was in before power-off. This occurs when the power is switched to an empty battery receptacle for more than 30 seconds, *or* when the power switch is set to OFF.

PIP-Warm Restart

1 With the device operating from battery 1, select Lead III. Remove the battery from battery 1 receptacle and insert it into battery 2 receptacle. Within 15 seconds perform steps 2 through 5 below.

2 Confirm that the device is off.

3 Rotate the POWER switch to battery 2.

4 Confirm that the device powers up without executing the full "cold start" routine.

5 Confirm that Lead III selection is retained.

6 Repeat steps 1 through 5 for battery receptacles 3 and 1 (moving the battery from battery receptacle 2 to battery receptacle 3, and then from battery receptacle 3 to battery receptacle 1).

7 If an optional Auxiliary Power Module is available, connect the DC output cable to the AUX connector on the device.

8 Repeat steps 1 through 5 for the AUX position.

PIP-Cold Restart

With the device operating from battery 1, select Lead III. Rotate the POWER switch to OFF, then rotate it to battery 1.

1 Confirm that the full "cold start" routine is executed.

2 Confirm that Lead II or Paddles is selected.

Note: Rotating the POWER switch to OFF always causes a "cold start."

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PIP-Pacemaker Functional Tests

If the optional pacemaker is installed, perform the following tests. Use the ECG simulator to input a 1mV, 30bpm NSR signal through the ECG cable. Press PACER and confirm the green pacemaker LED turns on.

1. Confirm that the Status Display shows 040 SET and 0mA and that the QRS sense markers are displayed on the CRT.
2. Connect the pacing cable to the PACE connector and pacemaker tester.
3. Press START/STOP and confirm that the LED illuminates and flashes as each pacing pulse is delivered.
4. Confirm that the output current can be adjusted up to 200 mA and down to 0mA by pressing the 5mA and 20mA buttons.
5. Confirm that the pacing rate can be adjusted up to 170ppm (or 140ppm if that is the maximum set in the options mode) and down to 40ppm by pressing the pacing ▼ RATE ▲ buttons.
6. Select 100mA output current at 80bpm.
7. Confirm that the pacing markers (upward, positive-going spikes on the ECG waveform) are visible on the CRT display.
8. Press RECORD and confirm that the QRS markers and pacing markers are printed.

   Note: The pacing markers are small arrows printed at the bottom edge of the recorder paper. The QRS markers are the small squares printed on the R wave on the recorder paper.
9. Set the ECG simulator to a value greater than 80bpm.
10. Confirm that pacing is discontinued. Turn the recorder off, reduce the simulator rate to 30bpm, and confirm that pacing resumes.
11. Disconnect the pacing cable at the pacing output connector. Confirm that a two tone alarm sounds and that pacing discontinues.
12. Reconnect the pacing cable and confirm that the Status Display now shows 080 SET and 0mA. Press PACER to turn off the pacemaker.

PIP-Pacemaker Output Tests

Connect a pacemaker tester to the device patient connector.

1. Press PACER and then START/STOP to turn on the pacemaker. Select a pace rate of 70ppm and a current of 100mA.
2. Confirm that the pacing pulses are delivered to the tester at 70 ± 1ppm and the output current is 100 ± 3mA.
3. Adjust the pace current to 200mA and the output rate to maximum. Confirm that the pulses delivered to the tester are now 170 ± 2ppm (or 140 ± 2ppm if 140 is the maximum set in the options mode) and 200 ± 6mA.
4. Press PACER to turn off the pacemaker.
5. Disconnect the patient ECG cable from the ECG simulator.

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PIP-Defibrillator Control and QUIK-LOOK

Press LEAD SELECT to select paddles lead.

1. Confirm that the paddle symbol is visible on the Status Display.
2. Hold the ECG simulator connections to the paddles (APEX on LL, STERNUM on RA) and confirm that a positive-going QRS is visible on the display.
3. Press and hold ECG SIZE (▲) until you hear three beeps to make sure ECG size is set at maximum.
4. Press the paddles together so that they are electrically shorted. Confirm that the CRT trace returns to the baseline within 3 seconds, with less than 3mm p-p baseline noise present.
5. Press the LEAD SELECT button to select Lead II.
6. Rotate the ENERGY select switch to 0J and press CHARGE. Confirm that the device does not charge.
7. Rotate the ENERGY select switch to 200J, and press CHARGE. Confirm that the paddle charge indicator flashes at a nominal 1Hz rate and glows steadily when the charge cycle is completed.

PIP-Energy Output

1. Rotate the ENERGY select switch to 5J and press CHARGE. Confirm that the defibrillator charges and that a brief charging tone sounds.
2. Confirm that when the "ready" state is achieved, the CHARGE indicator illuminates and the ready tone sounds.
3. Confirm that the available energy display on the defibrillator indicates the nominal value for the selected range.
4. Discharge the stored defibrillator energy into the energy meter. Confirm that the selected energy equals the externally measured energy ±7%.
5. Repeat steps 1 through 4 to confirm each energy selection from 10-360J.
6. Rotate the POWER switch to OFF.

PIP-Refresh and Auto-Dump

1. Rotate the power switch to BATT 1 and charge the defibrillator to 360J.
2. When charging is complete (charge light changes from flashing to steady), begin timing. Confirm that the device automatically discharges the stored energy internally (the Energy Indicator blanks) after 60 ±3 seconds.
3. Charge the defibrillator to 360J.
4. Rotate the ENERGY select switch to 5J. Confirm that the device automatically discharges the stored energy internally.
5. Press the PACER and START/STOP buttons. Confirm that pacing is initiated.
6. Charge the defibrillator to 100J. Confirm that pacing is discontinued as soon as the charge is initiated.
7. Discharge the energy into the external energy meter. Confirm that pacing does not automatically resume after energy is discharged into the energy meter.
8. Rotate the POWER switch to OFF.

PIP-External Power Operation

Connect an AC or DC Auxiliary Power Module to the AUX input.

1. Rotate the POWER switch from OFF to the AUX position.
2. Confirm that all Status Display messages, three battery indicators, pacemaker LEDs, and the paddle charge indicator illuminate for approximately 3 seconds and then extinguish.
3. Place the defibrillator paddles on the external energy meter.
4. Charge the defibrillator to 360J and then discharge the energy into the external energy meter. Confirm that the discharged energy is between 335J and 385J (±7%).
5. Rotate the POWER switch from AUX to OFF and disconnect the AC or DC Auxiliary Power Module from the AUX input.

PIP-Fault Stack Recheck

Check the Fault Stack to access the self-diagnostic feature of the LIFEPAK 10 defibrillator/monitor/pacemaker. If a failure occurs while this PIP is performed, the appropriate failure code(s) is (are) logged. Table 3-11 (page 3-36) lists all of the possible failure codes and corresponding failures.

1. Rotate the POWER switch to OFF.
2. Insert the Programming Key into the AUX connector, and rotate the POWER switch to battery 1.
3. Press the FREEZE key twice to scroll to the failure code data screen.
4. Write down a list of any displayed failure codes (press QRS VOL to sequentially display the numerical codes; any number other than 00 is a failure code). If any failure codes are displayed, refer to Table 3-11 (page 3-36), Test and Calibration (page 3-18), and Troubleshooting Aids (page 3-32) to identify and correct the cause(s) for the failure codes.

PIP-Leakage Current

Check leakage current in accordance with AAMI/ANSI (Association for the Advancement of Medical Instrumentation/American National Standards Institute) ES1-1993, AAMI/ANSI DF2-1996, IEC (International Electrotechnical Commission) 601-1 and IEC 601-2-4. Because of the wide variety of Safety Analyzers that may be used for these tests, only general instructions are provided in this manual. See Figure 3-1 and Figure 3-2 for connection diagrams. Refer to your Safety Analyzer operator's manual for instructions about configuring and performing these tests. The maximum allowable leakage current is summarized in Table 3-2, Table 3-3, and Table 3-4.

⚠ WARNING

Electrical hazard. Make sure you are familiar with your test equipment and how to execute these tests. Failure to properly perform these tests could result in not detecting excessive leakage current.

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Table 3-2 Maximum Leakage Current for Patient Contact Tests

Patient Contact Tests	Power Source: Battery or AC or DC Auxiliary Power Module (115 Vac)			Power Source: AC Auxiliary Power Module (230 Vac)		
	ECG Leads	Pacemaker Leads	External Paddles	ECG Leads	Pacemaker Leads	External Paddles
Patient Source Current	10μA	10μA	100μA	50μA	50μA	500μA
Patient Sink Current	10μA*	10μA*	100μA	50μA	50μA	500μA

* Value as measured at patient cable input. If measurement is taken at end of patient cable, add 10μA.

NOTES:

1 **Patient Source Current—ECG Leads.** Defibrillator power is on, lead II selected. Patient cable connected between defibrillator/monitor/pacemaker and leakage analyzer ECG posts. Standard paddles are in paddle wells. Perform LEAD-to-LEAD (INTERLEAD) and LEAD-to-GND tests. See Figure 3-1 or Figure 3-2 for test connections.

2 **Patient Sink Current—ECG Leads.** Similar to note 1 above. Defibrillator power is off. See Figure 3-1 or Figure 3-2 for test connections.

Table 3-3 Maximum Leakage Current for Chassis Leakage Tests

Chassis Leakage Tests	Power Source: Battery or AC or DC Auxiliary Module (115 Vac)	Power Source: AC or DC Auxiliary Power Module (230 Vac)
Ground Intact	100μA	100μA
Ground Open	300μA	500μA

NOTES:

1 If the LIFEPAK 10 defibrillator/monitor/pacemaker is ever used with an AC Auxiliary Power Module, leakage testing *must* be performed with an AC Auxiliary Power Module. If the LIFEPAK 10 defibrillator/monitor/pacemaker is never used with an AC Auxiliary Power Module, leakage testing *may* be performed with a battery as power source.

2 Refer to Figure 3-1 or Figure 3-2 for test connections.

3 Defibrillator power is on, lead II selected. Patient cable is connected between defibrillator/monitor/pacemaker and leakage analyzer ECG posts. Perform test with connection to each positive battery terminal in each battery well and the negative battery terminal in the farthest right battery well and ground post on Auxiliary Power Supply (if the power supply has a ground post). Measure for normal polarity, reverse polarity, and open ground.

Table 3-4 Maximum Leakage Current for Earth Leakage Tests

Earth	Domestic	International	
	120V (nominal)	230V (nominal)	264V (high line*)
Neutral Closed	2.5mA	2.1mA	2.5mA
Neutral Open	5mA	4.3mA	5mA

* If your leakage current analyzer does not have high-line measurement capability, use the nominal current limit.

* Earth leakage testing is only applicable if the LIFEPAK 10 is powered by the AC Auxiliary Power Supply. Earth leakage current is the current in the third wire safety ground wire of the AC power cord.

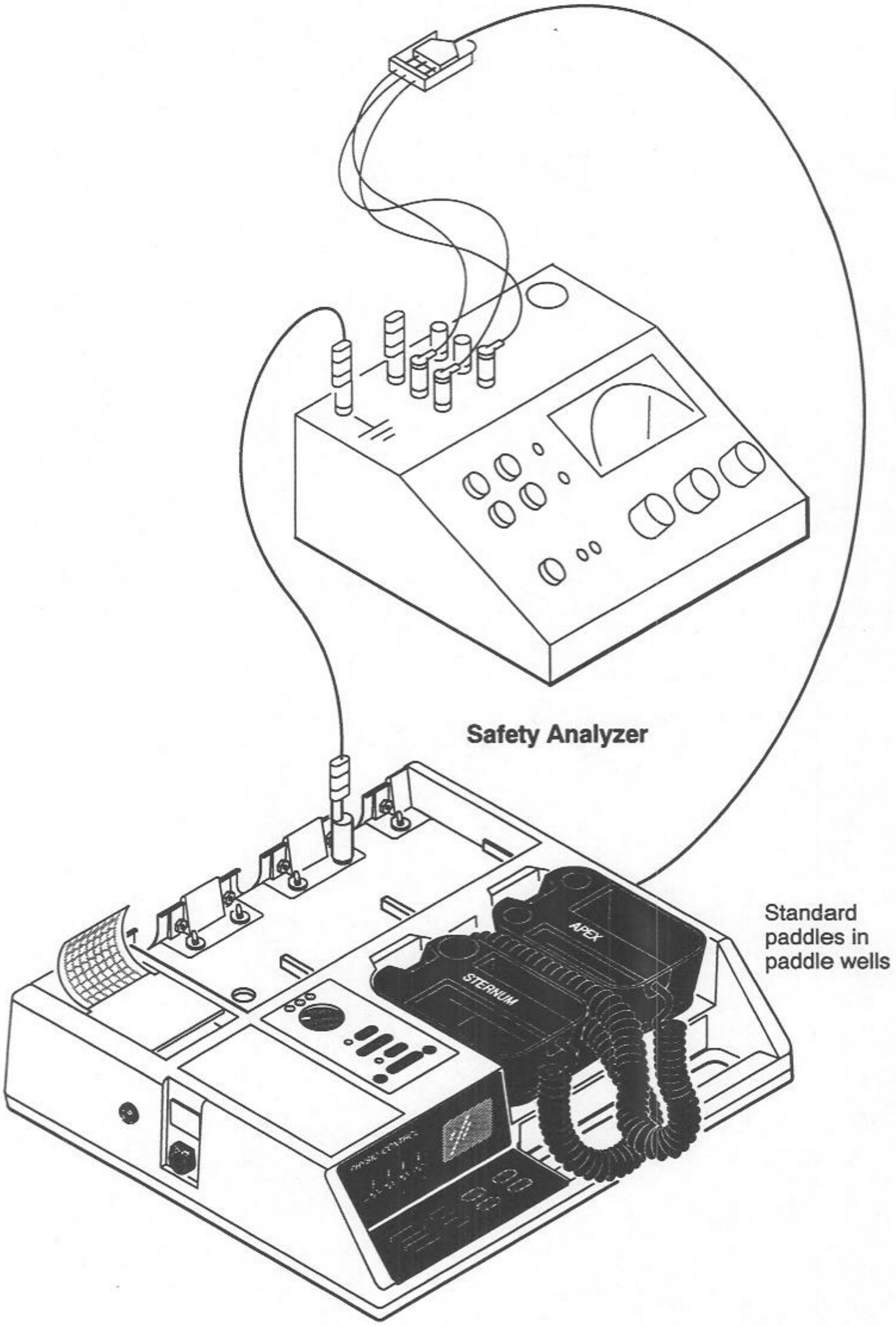
Safety Analyzer
Standard paddles in paddle wells
APEX
STERNUM

Figure 3-1 Chassis Leakage Test Connections

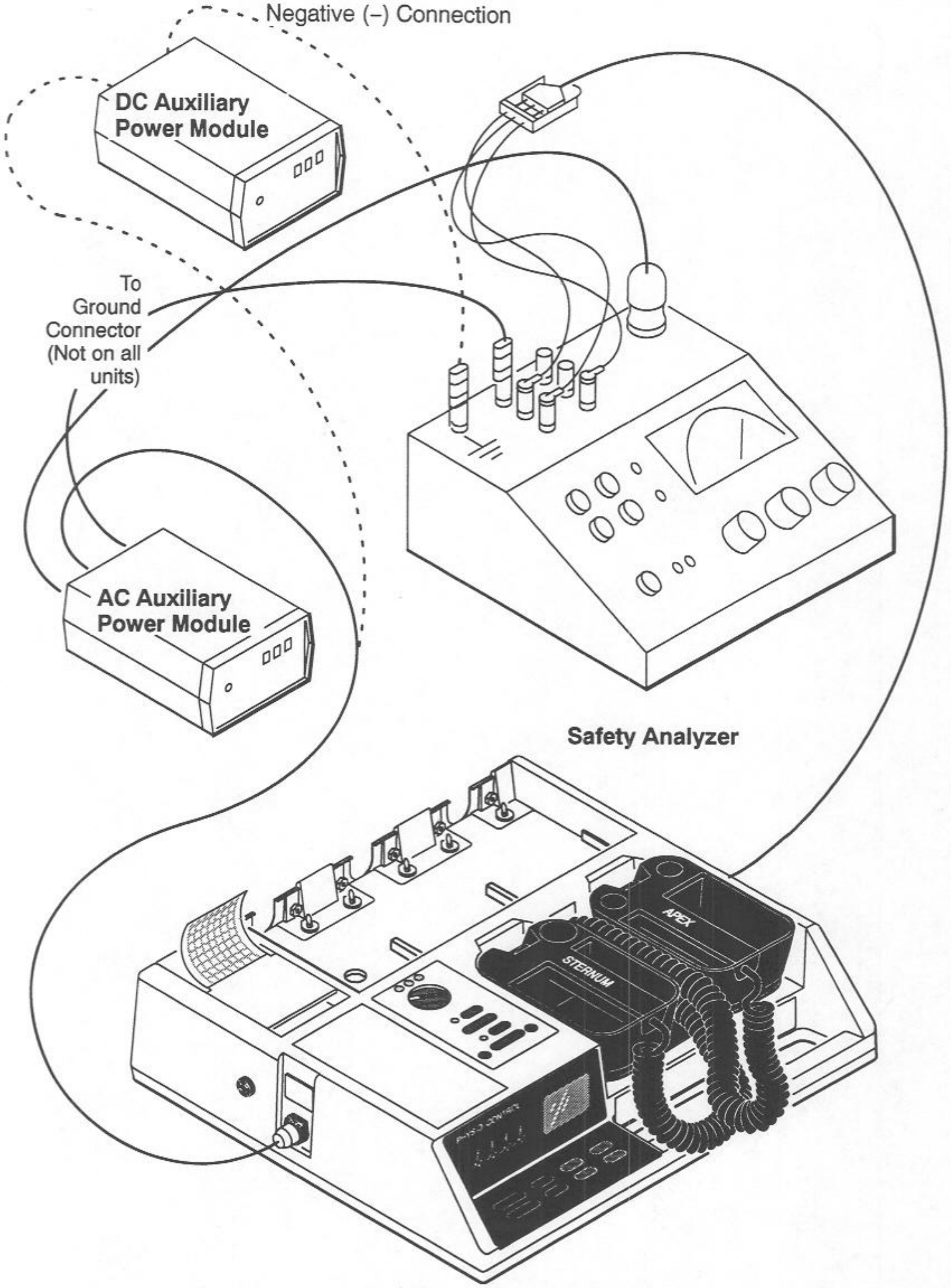
Negative (–) Connection
DC Auxiliary Power Module
To Ground Connector (Not on all units)
AC Auxiliary Power Module
Safety Analyzer
APEX
STERNUM

Figure 3-2 Leakage Test Connections with External Power Source

PIP-12 Lead ECG Adapter (option)

Follow these steps to test the optional 12 lead ECG adapter. This procedure requires use of a 12 lead ECG patient simulator and access to the diagnostic response mode.

1. Connect the 12 lead adapter 6-pin cable to the LIFEPAK 10 defibrillator/monitor/pacemaker patient ECG connector.
2. Connect the 10 snap connectors from the 12 lead adapter to the appropriate connections on the patient simulator.
3. Select 60bpm on the patient simulator.
4. With the device POWER switch set to battery 1, press and hold the RECORD button until the device displays DIAG. Make sure Lead II is selected (press LEAD SELECT if necessary).

   Note: If the device does not display DIAG, make sure that the option number o01 is set to 1 to enable the diagnostic mode as described on page 2-10.

5. On the 12 lead adapter, set the LIMB LEADS switch to position I (the V LEADS switch position does not matter). Confirm that the defibrillator/monitor displays a heart rate of 60 ±4bpm as listed in Table 3-5 on page 3-15. Inspect the recorder output and confirm that the recording is very similar in shape and amplitude to the Lead I position shown in Figure 3-3 on page 3-16.
6. Repeat Step 5 for each of the other 11 switch settings listed in Table 3-5.
7. Set the LIMB LEADS switch to position AVL.
8. Press the SYNC button on the defibrillator/monitor. Press the ECG SIZE (▲) and the QRS VOL (▲) buttons as needed until the defibrillator/monitor begins to beep indicating detection of R waves. Confirm that the defibrillator/monitor displays a heart rate of 60 ±4bpm.
9. Set the LIMB LEADS switch to position III. Confirm that the defibrillator/monitor displays a heart rate of 60 ±4bpm. Press the SYNC button to deselect synchronization.
10. Press the ECG SIZE (▲) button as needed to increase the ECG size to x4. (Press the RECORD button and examine the annotation on the printout to confirm the x4 setting, then press the RECORD button to turn off the recorder.)
11. Set the LIMB LEADS switch to position I. Press the RECORD button and let the recorder print for at least 2 seconds. Change the LIMB LEADS switch to position II. Confirm that the recorded signal recovers to within 5mm of the baseline trace within 4 seconds of changing the switch.
12. Repeat step 11 for each of the other switch settings listed in Table 3-5.

Note: After you complete the PIP, be sure to enter the options mode (as described on page 2-10) and reenter the user's original settings.

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Table 3-5 12 Lead ECG Adapter Switch Settings

Lead Selection	12 Lead Adapter Switch Settings		Expected Result	
	Limb Leads	V Leads	Heart Rate	Amplitude**
1. LEAD I	I	(n/a)*	60 ±4bpm	8 ±2mm
2. LEAD II	II	(n/a)*	60 ±4bpm	11 ±2mm
3. LEAD III	III	(n/a)*	-	4 ±2mm
4. AVR	AVR	(n/a)*	60 ±4bpm	9 ±2mm
5. AVL	AVL	(n/a)*	-	2 ±2mm
6. AVF	AVF	(n/a)*	60 ±4bpm	8 ±2mm
7. V1	V LEADS	1	60 ±4bpm	8 ±2mm
8. V2	V LEADS	2	60 ±4bpm	15 ±2mm
9. V3	V LEADS	3	60 ±4bpm	18 ±2mm
10. V4	V LEADS	4	60 ±4bpm	16 ±2mm
11. V5	V LEADS	5	60 ±4bpm	14 ±2mm
12. V6	V LEADS	6	60 ±4bpm	10 ±2mm

* n/a = Not Applicable (V LEADS switch may be in any position).
** ECG Size = x1.

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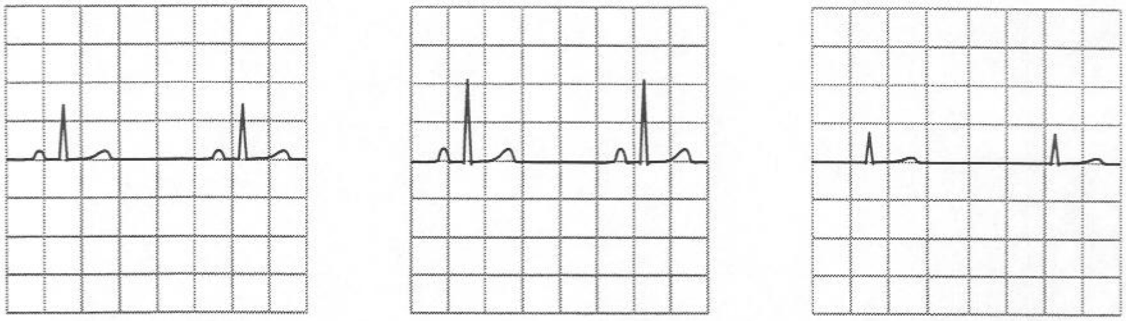
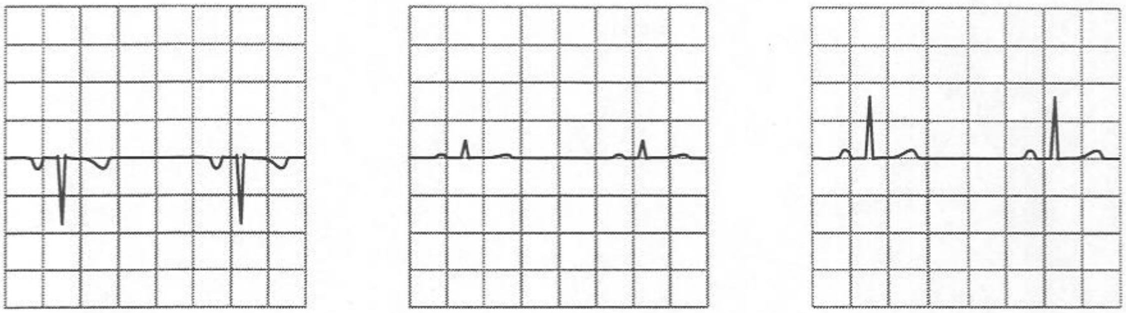
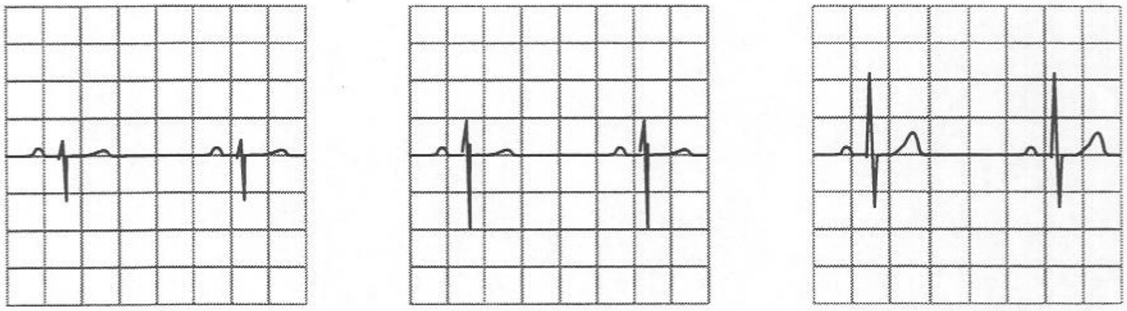


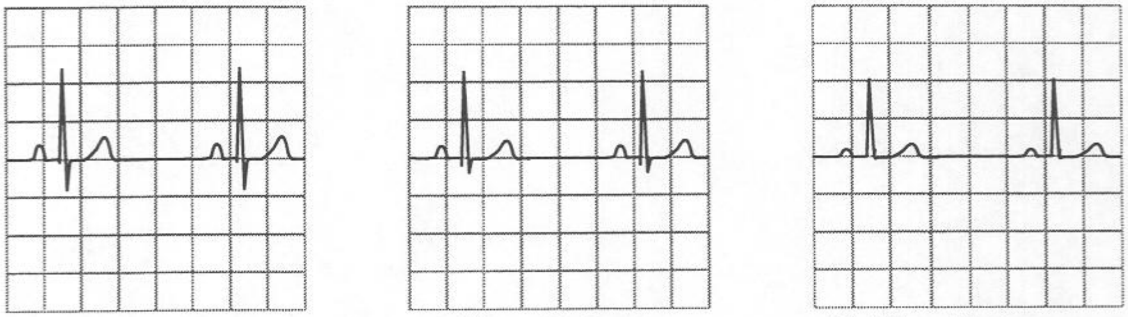
1. **Lead I** 8 ±2mm
2. **Lead II** 11 ±2mm
3. **Lead III** 4 ±2mm



4. **AVR** 9 ±2mm
5. **AVL** 2 ±2mm
6. **AVF** 8 ±2mm



7. **V1** 8 ±2mm
8. **V2** 15 ±2mm
9. **V3** 18 ±2mm



10. **V4** 16 ±2mm
11. **V5** 14 ±2mm
12. **V6** 10 ±2mm

Figure 3-3 Expected Recorder Outputs for 12-Lead ECG Adapter Switch Positions

PIP Checklist

Customer: ______________________ Date: __________
Dept/Location: ______________________
Device Type: ______________________ Model: __________
Serial Number: ______________________
Frequency: ______________________ Last Insp: __________
Tech. Name/ID: ______________________

Performance Inspection	Pass	Fail	Comments
Physical Inspection	☐	☐	
Power-on Sequence	☐	☐	
Fault Stack Check	☐	☐	
Paper-out Sensor and Recorder Speed	☐	☐	
CODE SUMMARY	☐	☐	
Freeze and ECG Audio Checks	☐	☐	
Preamplifier Baseline Noise and CAL Pulse Checks	☐	☐	
Heart Rate and Lead Polarity	☐	☐	
Synchronized Cardioversion	☐	☐	
Warm/Cold Restart Check	☐	☐	
Pacer Output Path	☐	☐	
Pacemaker Functional Tests	☐	☐	
Pacemaker Output Tests	☐	☐	
Defibrillator Control and QUIK-LOOK	☐	☐	
Energy Output	☐	☐	
Refresh and Auto-Dump	☐	☐	
External Power Operation	☐	☐	
Fault Stack Recheck	☐	☐	
Leakage Current	☐	☐	
12 Lead ECG Adapter (If installed)	☐	☐	

Test and Calibration Procedure (TCP)

Perform the applicable tests in this section:

- If the LIFEPAK 10 defibrillator/monitor/pacemaker fails a PIP test
- If there is a suspected assembly failure
- If there are any open-case repairs

Each TCP test may be performed separately. The TCP Checklist (page 3-31) may be photocopied and used to record results. If the device fails to pass a test, refer to Troubleshooting Aids on page 3-32. Some tests require opening the case. After performing any of these tests, perform the PIP.

TCP-Applicability

This Test and Calibration procedure applies to all configurations of the LIFEPAK 10 defibrillator/monitor/pacemaker.

This procedure does *not* apply to the LIFEPAK 10C defibrillator/monitor/pacemaker.

TCP-Definitions

Acronyms used in these tests include:

ECG	Electrocardiogram
ESD	Electrical Static Discharge
MIEMSS	Maryland Institute of Emergency Medical Services Systems
NSR	Normal Sinus Rhythm
PIP	Performance Inspection Procedure
QRS or QRS Complex	Refers to portions of the ECG waveform
SSD	Static-Sensitive Device
TCP	Test and Calibration Procedure

TCP-Requirements

The following are *minimum* requirements:

TCP-Equipment Requirements

Test equipment required for the TCP tests is listed in Table 3-6. Although specific test equipment is recommended, other test equipment with equivalent specifications can be used.

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Table 3-6 Test and Calibration Test Equipment

Equipment	Specifications	Manufacturer
Oscilloscope	Bandwidth: dc to 50MHz	Tektronix Model 2225 or equivalent*
Digital Multimeter (DMM)	3-1/2 digits Range: 0 to 1500V full scale Current range: 0 to 10A Input Resistance: 10MΩ	Fluke Model 8010 or equivalent*
High Voltage Probe	1000:1 divider, ≥20kV	Fluke Model 80K-40 or equivalent*
ECG Simulator	Amplitude: 2.0 ± 0.5mV Frequency: @10Hz ±0.5Hz @60Hz ±1%	Bio-Tek QED-6 or equivalent*
Defibrillator Energy Meter	Power Range: 0-400J Load Resistance: 50Ω ±10% Accuracy: ±3%	Bio-Tek QED-6 or equivalent*
LIFEPAK 10 Programming Key		(Physio-Control PN 805144, provided with device)
ECG Lead Shorting Plug		(Refer to Figure 3-4)
8Ω speaker and 200Ω resistor		(For MIEMSS Modulator PCB only, refer to Figure 3-8)

* Equivalent equipment is required to meet the specifications listed in the specifications column.

TCP-Test Equipment Validation

All test equipment used to perform the TCP must have a current calibration label affixed to its exterior. The calibration label must be issued by a certified calibration facility.

TCP-Workstation Requirements

Workstations where the TCP is performed must provide an Electrical Static Discharge (ESD) protected environment. If ac line power is provided to this workstation, it must be connected to a grounded power source.

TCP-Personnel

Personnel performing this TCP must be thoroughly familiar with the operation of the LIFEPAK 10 defibrillator/monitor/pacemaker. Personnel performing this TCP must meet one or more of the following levels of education or experience:

- Associate of applied science degree with a major emphasis in biomedical electronics
- Certificate of technical training in electronics with a major emphasis in biomedical electronics
- Equivalent biomedical electronics experience

⚠ WARNING

Shock hazard. Be sure to remove batteries and disconnect the Auxiliary Power Module (if connected) before removing the top cover.

⚠ CAUTION

Possible component damage. Static Sensitive Devices (SSDs) require special handling. Follow the special handling procedures described on page 4-16 to prevent static discharge and damage. Refer to Table 5-1 to identify PCB assemblies containing SSDs which are indicated by this symbol:

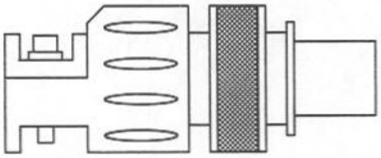
⚠ CAUTION

Possible corruption of defibrillator constants and options settings. When changing status selections or values in the options mode, after pressing CAL to enter the new value wait at least **one full second** before rotating the POWER switch to OFF to allow the System PCB microprocessor sufficient time to properly store the changes. If power is removed in less than one second, the EEROM memory contents may be corrupted, including the defibrillator calibration constants and the options mode status selections. If the EEROM memory contents are corrupted, the device will display the service indicator symbol indicating a failure code has been recorded. To investigate the failure, refer to Table 2-4 (page 2-10) and Status Display Failure Codes (page 3-36). To restore the correct EEROM memory contents, reselect the proper options mode status selections and perform the Test and Calibration Procedures (TCP) for TCP-Defibrillator Calibration, TCP-AVAILABLE ENERGY Display, and TCP-Recorder Calibration (beginning on page 3-24).

TCP-System PCB Test and Calibration

The test and calibration procedures for the System PCB follow. Before beginning, confirm that the device power is off and all batteries are removed.

Some of the following tests require that the patient connector inputs be shorted together. Using a shorting plug is one method of shorting the inputs. Construct an ECG shorting plug as shown in Figure 3-4.



6 PIN PATIENT CABLE CONNECTOR
(KEYED BETWEEN PIN A AND PIN F)
PART NUMBER 201316-000

NOTE: SHORT ALL PINS TOGETHER INSIDE BACKSHELL

Figure 3-4 ECG Shorting Plug

Refer to Figure 3-5 for potentiometer and connector locations. Refer to Figures 5-1 and 5-2 (pages 5-14 and 5-15) for assistance in properly reconnecting the wires and cables when reassembling the device.

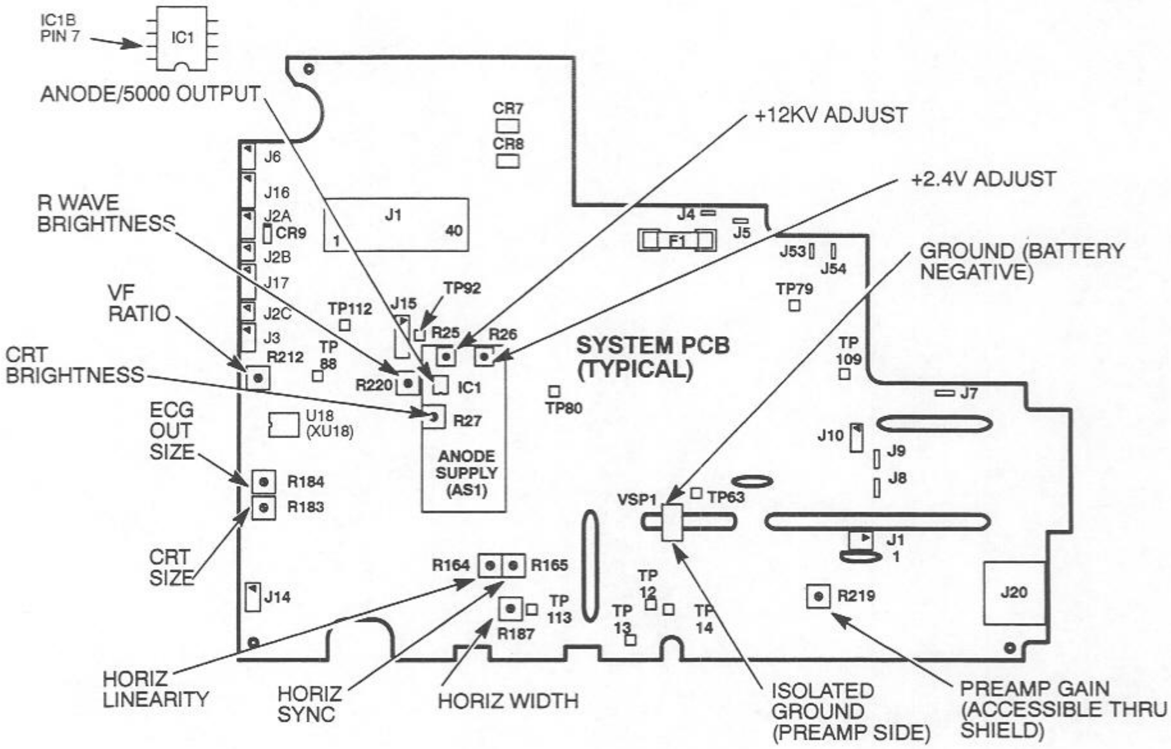

IC1B PIN 7
IC1
ANODE/5000 OUTPUT
CR7
CR8
+12KV ADJUST
+2.4V ADJUST
J6
J16
J2A
CR9
J2B
J17
J2C
J3
J1
1
40
J4
F1
J5
J53
J54
TP79
GROUND (BATTERY NEGATIVE)
R WAVE BRIGHTNESS
VF RATIO
CRT BRIGHTNESS
TP112
J15
TP92
R25
R26
TP 88
R212
R220
IC1
R27
SYSTEM PCB (TYPICAL)
TP80
TP 109
J7
ECG OUT SIZE
U18 (XU18)
ANODE SUPPLY (AS1)
J10
J9
J8
R184
R183
VSP1
TP63
J1
1
CRT SIZE
J14
R164
R165
TP 12
TP 13
TP 14
TP 113
R187
R219
J20
HORIZ LINEARITY
HORIZ SYNC
HORIZ WIDTH
ISOLATED GROUND (PREAMP SIDE)
PREAMP GAIN (ACCESSIBLE THRU SHIELD)

Figure 3-5 System PCB Potentiometer, Test Point, and Connector Locations

TCP-ECG Out and Preamp Gain

Separate both case halves (refer to Case Disassembly, page 4-18). Install battery in battery receptacle 1. Insert the Programming Key into the AUX connector, rotate the Power switch to the battery 1 position, and remove the Programming Key. The device is now in the options mode. (For more information about the options mode, refer to Options Mode Selection and Programming, page 2-7.)

1. Verify that option number o10 is set to 1 to enable the output of ECG to the AUX connector.
2. Press FREEZE repeatedly until C01 appears on the Status Display. At this point, observe three stationary "U" shapes visible on the CRT.
3. Press QRS VOL ▲ until C03 appears on the Status Display. This produces a 1Hz square wave on the CRT and activates the recorder. Open the recorder door to turn off the recorder.
4. Connect an oscilloscope to pin 5 of the AUX connector using pin 6 as the ground (see Figure 3-6). If necessary, adjust R184 (ECG Out Size) for an output of 2.3 ±0.1V p-p.

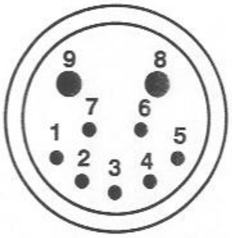


Figure 3-6 AUX Connector Pin Numbers

Note: Steps 5 through 10 describe how to adjust R219. If you have a System PCB that does not include R219, contact Physio-Control for assistance in upgrading the System PCB.

5 Rotate the POWER switch to OFF, then to the battery 1 position. Close the recorder door and install the ECG shorting plug, or connect the patient simulator to the patient connector with the power off. If not already in Lead II, press LEAD SELECT until Lead II displays.

6 Press the ECG SIZE (▲) button 5 times and increase ECG Size to x2.0.

7 Press and hold RECORD for 4 seconds to select diagnostic frequency response. (If the device does not display DIAG, make sure that the option number o01 is set to 1 to enable the diagnostic mode as described beginning on page 2-7.)

8 Press the CAL button repeatedly to generate pulses displayed on the CRT and printed by the recorder.

9 Confirm that the ECG size is x2.0 (as printed along the top margin of the paper). Adjust the ECG size if necessary to obtain x2.0 and press CAL to print new pulses.

10 Confirm that the amplitudes of the pulses printed on the recorder paper are 20 ±1mm. If necessary, adjust R219 (Preamp Gain).

Note: If adjustment of R219 is necessary, note that there is a 4-second delay between the time you adjust R219 and the time that the change appears on the paper. Remember to press CAL to produce the pulses.

11 Turn the recorder off. Use the ECG simulator to input a 1mV p-p 10Hz sine wave signal to the ECG connector. Turn the recorder on and confirm that the amplitude of the printed trace is 20 ± 1mm (with "x2.0" size enabled from the previous step). If not, repeat steps 5 through 10 above. Rotate the POWER switch to OFF.

TCP-CRT Display

With the case halves separated (described on page 4-18, Case Disassembly), connect the patient simulator to the device patient ECG connector. Input a 60bpm NSR signal. Adjust the potentiometers only if necessary.

1 Rotate POWER to battery 1 and select Lead II.

2 Adjust R164 (Horizontal Linearity) so that the horizontal spacing is even between each QRS complex.

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3. Adjust R187 (Horizontal Width) so that the horizontal spacing between each QRS complex, as measured from the peak of the signals, is 25 ± 1mm.
4. Alternate adjustment of R164 and R187 as needed to obtain evenly spaced signals 25 ± 1mm.
5. Adjust R165 (Horizontal Sync) for a stable, non-jitter display.
6. Adjust R183 (CRT Size) so that the peak of each QRS complex has an amplitude of 17 ± 1mm.
7. Rotate the POWER switch to OFF.

TCP-CRT Brightness

Rotate the POWER switch to OFF and insert the Programming Key into the AUX connector. Rotate the POWER switch to the battery 1 position and remove the Programming Key. The device is now in the options mode.

1. Press FREEZE until C01 displays. Then press QRS VOL (▲) so that a triangle waveform appears on the CRT. In a well-lit work area, adjust R27 (CRT Brightness on the Anode Power Supply; refer to Figure 3-5 on page 3-21 for the location) so the CRT trace is easily visible from five feet away, but without retrace. (Observe with the top cover *down* so that the green filter is in front of the CRT.)
2. Rotate the POWER switch to OFF, then to the battery 1 position. Make sure that Lead II is selected. Input a 1mV, 60bpm NSR signal.
3. In a well-lit work area, adjust R220 (R Wave Brightness) so that the R wave signal brightness matches the baseline brightness from five feet away. (Observe with top cover *down* so that the green filter is in front of the CRT.)

⚠ CAUTION

Possible CRT damage. Excessive CRT brightness may damage the CRT.

TCP-Modulated ECG Output

Rotate the POWER switch to OFF and insert the Programming Key into the AUX connector. Rotate the POWER switch to the battery 1 position and remove the Programming Key. The device is now in the options mode.

1. Select option o10, number 2. Short the patient connector by using either the ECG shorting plug or by connecting the patient simulator to the patient connector with the power off.
2. Connect the oscilloscope to pin 5 of the AUX connector using pin 6 as the ground (refer to Figure 3-6, page 3-22). If necessary, adjust R212 (VF Ratio) for an output of 1400 ± 28Hz (714 ± 14µs).
3. Reprogram the device for the desired auxiliary output signal.

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TCP-QRS Marks

Rotate the POWER switch to OFF and insert the Programming Key into the AUX connector. Rotate the POWER switch to the battery 1 position and remove the Programming Key. The device is now in the options mode.

1. Select option o10, number 3. Connect the oscilloscope to pin 5 of the AUX connector using pin 6 as the ground (refer to Figure 3-6, page 3-22).
2. Confirm that the output signal consists of +5 ±0.5V pulses, 1.6 ±0.2ms long, which correspond to the detected R wave.
3. Reprogram the device for the desired auxiliary output signal.

TCP-Defibrillator Calibration

Rotate the POWER switch to OFF, insert the Programming Key into the AUX connector, and rotate the POWER switch to the battery 1 position. Leave the Programming Key inserted for this procedure.

⚠ WARNING

Shock hazard. Make sure the upper case is placed on the device before performing the following steps.

Press FREEZE once to enter the defibrillator calibrate mode. Confirm that d01 and a calibration constant appear on the Status Display. The device is now in the options mode. Calibrate the defibrillator output energies as follows:

1. Remove the paddles from the paddle wells and rotate the energy select knob on the Sternum paddle to select 5J.

⚠ WARNING

Shock hazard. Keep defibrillator paddles on external energy meter at all times. Discharge the paddles into external energy meter as described.

2. Press the CHARGE button. When the defibrillator is fully charged, discharge the stored energy into the energy meter.

3 Note whether there is a difference between the selected energy and the actual energy delivered. If there is a difference, calibrate the defibrillator output using the following formula to determine the appropriate calibration factor:

(s – d) x m = calibration factor

where selected energy = s and delivered energy = d. The multiplication factor, m, is determined from the following table:

5J = 100
10J = 10
20J = 10
50J = 10
100J = 1
200J = 1
300J = 1
360J = 1

For example, if the selected energy is 5J and the delivered energy is 4.9J, the calibration factor is calculated as:

(5.0 – 4.9) x 100 = 10

In this example, 10 would be added to the value displayed on the Status Display. Sometimes correction factors can be negative. For example, if the selected energy is 10J and the delivered energy is 10.1J, the calibration factor is calculated as:

(10.0 – 10.1) x 10 = –1

In this example, 1 would be *subtracted* from the value on the Status Display.

4 Press the ▼ QRS VOL ▲ to adjust the value of the constant on the Status Display by the amount of the calibration factor. Carefully note the sign of the number.

5 Press CAL to enter the new display constant. Confirm that a beep tone is emitted indicating that the new value has been entered.

6 Select a new energy level setting on the Sternum Paddle.

7 Repeat for the remaining energy settings by pressing ECG SIZE (▲) to increment the Status Display to the corresponding settings as shown below:

d02 = 10J
d03 = 20J
d04 = 50J
d05 = 100J
d06 = 200J
d07 = 300J
d08 = 360J

8 Charge to the selected energy level, then discharge into the energy meter and calculate the calibration factor.

9. Continue until all the delivered energy ranges are calibrated to within 7% of the selected value. If you change the calibration constant, be sure to recheck each energy level.

TCP-AVAILABLE ENERGY Display

You must complete the Defibrillator Calibration Test before performing this calibration of the AVAILABLE ENERGY on the Status Display. Rotate the POWER switch to OFF, insert the Programming Key into the AUX connector, and rotate the POWER switch to the battery 1 position. The device is now in the options mode. Press FREEZE once to obtain d01 on the Status Display.

⚠ WARNING

Shock hazard. Keep defibrillator paddles on external energy meter at all times. Discharge the paddles into external energy meter as described.

1. Rotate the energy select knob to 5J. Press ECG SIZE (▲) to increase the Status Display to the d11 (5J) range.
2. Charge the defibrillator and observe the internal energy meter reading on the Status Display. This calibration constant should always be 50 for the 5J range.
3. If necessary to change the calibration constant, use the ▼ QRS VOL ▲ buttons to select the correct value.
4. Enter the correct calibration constant by pressing CAL. Confirm that a beep tone is emitted. Discharge the stored energy into the external energy meter.
5. For each defibrillation energy range, follow steps 1 through 4 and enter the calibration constants shown below:

Status Display Option	Energy Range	CAL Constant
d11	5J	50
d12	10J	100
d13	20J	200
d14	50J	50
d15	100J	100
d16	200J	200
d17	300J	not calibrated
d18	360J	360

Note: The 300J range does not require calibration.

6. When all calibrations are completed, turn off device power.

TCP-Chart/Pacer PCB Test and Calibration

The following paragraphs describe the test and calibration procedures for the Chart/Pacer PCB. Refer to Figure 3-7 for potentiometer, Test Point, and Connector Locations.

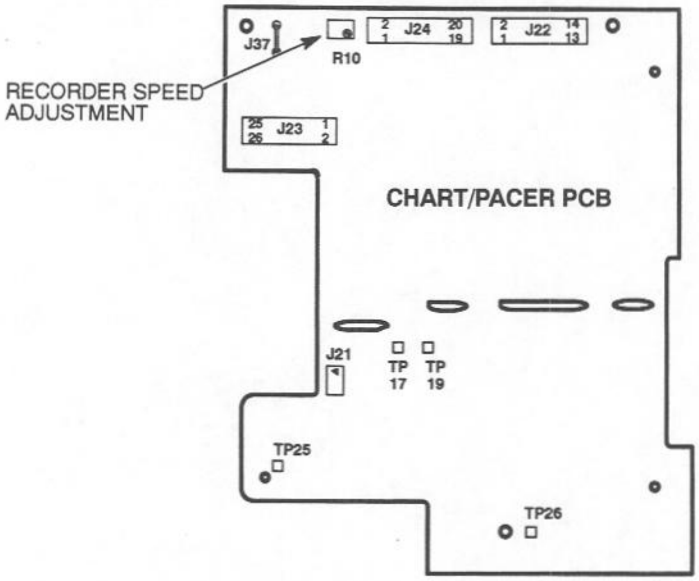

Figure 3-7 Chart/Pacer PCB potentiometer, Test Point and Converter Locations

TCP-Recorder Calibration

Make sure that paper is installed in the recorder. Install the battery in battery 2 receptacle. Rotate the POWER switch to OFF and insert the Programming Key into the AUX connector. Rotate the POWER switch to battery 2 and remove the Programming Key. The device is now in the options mode.

1. While the device is in the options mode, press and hold the RECORD button on the Main Control Panel. Confirm that the recorder prints the entire character set and continues to do so as long as RECORD is pressed.
2. Release RECORD.
3. Press FREEZE repeatedly until the letter A appears on the Status Display followed by a three-digit number. Compare this number with the number printed on the recorder printhead label. If the displayed number differs, use the QRS VOL buttons (▲ or ▼) to enter the label number onto the display.

   Note: It may be necessary to press and hold the QRS VOL button for as long as 2 seconds before the value changes on the display.
4. With the correct number displayed, press CAL. Confirm that a beep tone sounds, indicating that the displayed value has been loaded into memory.
5. Rotate the POWER switch to OFF, and then to battery 2.

Note: The actual stored value may not match the entered value. The software maintains a table of eight discrete resistance factors. When a resistance factor is entered during calibration, the software stores the value from its table that is *closest* to the entered value. Refer to Table 3-7.

Table 3-7 Printhead Resistance Factors

Resistance Value Entered	Value Stored
<595	595
595 - 630	612
631 - 665	648
666 - 700	683
701 - 735	718
736 - 770	753
771 - 804	788
>805	805

6 Connect the ECG leads to the ECG simulator.

7 Apply a 1mV, 60bpm NSR signal to the patient ECG cable leads.

8 Press LEAD SELECT until Lead II is selected. Confirm the display of the NSR waveform on the CRT. Press RECORD and confirm that an NSR waveform is printed on the recorder paper.

9 The adjustment potentiometer for this step is located under the rubber plug in the battery 1 compartment. If necessary, adjust R10 for 25 ±1mm between R wave peaks on the recorder.

10 Confirm that a status message is printed every 20 seconds on the upper margin of the recorder paper consisting of the following:

(Time) (Date) Lead II X1.0 HR=60.

11 Confirm that the time information is the only parameter that changes with successive messages, then press RECORD to turn off the recorder.

TCP-Anode Power Supply Test and Calibration

Refer to Figure 3-5 on page 3-21 for the locations of the Anode Power Supply potentiometers and measurement locations.

1 Make sure that a battery is installed in battery receptacle 1 and rotate the POWER switch to the battery 1 position. If the device has not been operating, wait at least 2 minutes to allow the CRT intensity to stabilize.

⚠ WARNING

Shock hazard. Extremely high voltage (12kV) is present at the CRT anode connector (P30). Do not allow any bodily contact with the CRT anode connector or associated circuitry.

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2 Using a high voltage probe connected to the DMM, measure the voltage at the CRT anode connector (P30) and confirm the voltage is 12.0 ±0.1kV. If necessary, adjust R25 to obtain the proper voltage. If adjustment of R25 is required, wait two minutes after adjusting R25, recheck the measurement, and re-adjust if necessary.

Note: Be sure to insert the high voltage probe tip far enough under the foam and rubber cap on the CRT anode connector to make good electrical contact with the anode connector.

3 Measure the voltage at IC1B pin 7 (the ANODE/5000 output) and confirm the voltage is +2.40 ±0.05Vdc. If necessary, adjust R26 to obtain the proper voltage.

4 Perform the TCP-CRT Display adjustment and the TCP-CRT Brightness adjustment as described on page 3-23 to make sure that the CRT brightness is properly adjusted.

TCP-MIEMSS Modulator PCB Test and Calibration (If Installed)

The following tests confirm the operating power and allow output calibration of the optional MIEMSS Modulator PCB. Perform the tests with the device case opened (as described on page 4-18, Case Disassembly) to access the MIEMSS Modulator PCB.

⚠ WARNING

Shock hazard. Disconnect power before disassembling the case halves to access the MIEMSS Modulator PCB.

TCP-Frequency Calibration

1 Install a battery in battery receptacle 1. Rotate POWER to battery 1.

2 Connect an oscilloscope to U2 pin 4; connect to the battery negative ground on VSP1 on the System PCB (for location see Figure 3-5 on page 3-21). Install the ECG shorting plug.

3 Confirm that the output at pin 4 is a 1400 ±28Hz (714 ±14μs) triangle waveform. Adjust potentiometer R6 if necessary.

TCP-Output Gain

1 Connect the test setup as shown in Figure 3-8.

2 Confirm that the following signals are audible and meet the specification listed in Table 3-8. Adjust potentiometer R9 if necessary. (The signals may also be monitored from the test setup.)

Table 3-8 MIEMSS Modulator Outputs

Location	Outputs
P2 pin 2	Triangle waveform, +200 ±20mV p-p, 1400 ±28Hz
P2 pin 3	Triangle waveform, 1.2 to 1.55V p-p, 1400 ±28Hz
P2 pin 4	Ground

3 Connect the patient simulator to the patient input and set a 10Hz 1mV sine wave for the output. Press LEAD SELECT to display Lead II.

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4 Confirm that there is a positive-going NSR signal at P2 pin 1 with an amplitude of 1.0 ±0.2V p-p.

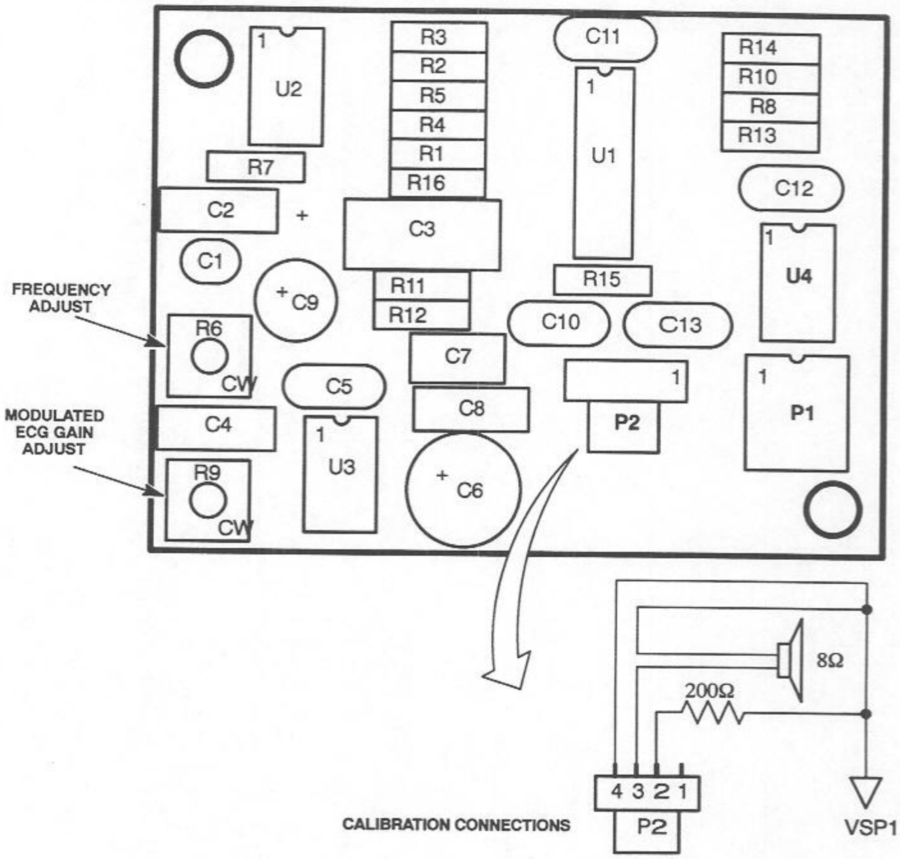
U2
1
R3
R2
R5
R4
R1
R16
R7
C2
+
C3
C11
U1
1
R14
R10
R8
R13
C12
U4
1
C1
+C9
R11
R12
R15
C10
C13
FREQUENCY ADJUST
R6
CW
C5
C7
1
P1
1
C8
P2
MODULATED ECG GAIN ADJUST
C4
U3
1
R9
CW
+C6
8Ω
200Ω
4 3 2 1
P2
VSP1
CALIBRATION CONNECTIONS

Figure 3-8 MIEMSS Calibration Setup

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TCP Checklist

Customer: ______________________ Date: __________
Dept/Location: ______________________
Device Type: ______________________ Model: __________
Serial Number: ______________________
Frequency: ______________________ Last Insp: __________
Tech. Name/ID: ______________________

Test and Calibration	Pass	Fail	Comments
System PCB Test and Calibration			
ECG Out/Preamp Gain	☐	☐	______
CRT Display	☐	☐	______
CRT Brightness	☐	☐	______
Modulated ECG Output	☐	☐	______
QRS Marks	☐	☐	______
Defibrillator Calibration	☐	☐	______
AVAILABLE ENERGY Display	☐	☐	______
Chart/Pacer PCB Test and Calibration			
Recorder Calibration	☐	☐	______
Anode Power Supply Test and Calibration			
	☐	☐	______
MIEMSS Modulator PCB Test and Calibration*			
Frequency Calibration	☐	☐	______
Output Gain	☐	☐	______

*If installed

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Troubleshooting Aids

The information in this section may help a service technician isolate possible failures. It includes troubleshooting tests, Status Display Panel Failure Code descriptions, and a table to help decode the Main Control Panel Keyboard. For each procedure, use battery power unless instructed otherwise.

If a device failure cannot be isolated and repaired, contact a Physio-Control representative. In the US call 1-800-442-1142. While Physio-Control Corporation recommends that the device not be used until the failure has been resolved and the device passes the Performance Inspection Procedure (PIP) on page 3-1, professional discretion based on circumstance may warrant exception.

Troubleshooting Tests

The following tests provide troubleshooting assistance. The required test equipment is listed in Table 3-9. The requirements for test equipment validation, the workstation, and personnel qualifications are the same as those listed for the Test and Calibration Procedure (TCP) beginning on page 3-18.

Table 3-9 Test Equipment Required for Troubleshooting

Equipment	Specifications	Manufacturer
DC Power Supply	Output Voltage: 0 to 20Vdc Output Current: 0 to 3A	Topward Model TPS 2000 or equivalent*
Digital Multimeter (DMM)	3-1/2 digits Range: 0 to 1500V full scale Current range: 0 to 10A Input Resistance: 10MΩ	Fluke Model 8010 or equivalent*
Defibrillator Analyzer	Power Range: 0-400J Load Resistance: 50Ω ± 10% Accuracy: ±3% Waveform Playback Capacity	Bio-Tek QED-6 or equivalent*

* Equivalent equipment is required to meet the specifications listed in the specifications column.

⚠ WARNING

Shock hazard. Be sure to remove batteries and disconnect the Auxiliary Power Module (if connected) before removing the top cover.

⚠ CAUTION

Possible component damage. Static Sensitive Devices (SSDs) require special handling. Follow the special handling procedures described on page 4-16 to prevent static discharge and damage. Refer to Table 5-1 to identify PCB assemblies containing SSDs which are indicated by this symbol:

Power-Up and Power-Down Tests

Make sure that power is off to the device and to the dc power supply. Turn on power to the dc power supply, set the power to +12V, then turn the power off. Connect the dc power supply and a DMM in series with the battery 1 terminals. Observe proper polarity as indicated near the battery terminal posts. Turn on power to the power supply and adjust the power supply output to +12.0 ±0.1Vdc.

⚠ CAUTION

Possible equipment damage. Power-up current exceeds 2A. Use the 10A current range on the DMM.

1. Rotate the POWER switch to the battery 1 position.
2. Confirm that the stabilized current draw from the battery is less than 1A.
3. Confirm that the stabilized current draw from the battery with the recorder running is less than 1.2A.
4. Confirm that the device performs a display test and powers-up with Lead II or paddles lead selected.
5. Confirm that the CRT display brightness is acceptable after warm-up (15 seconds).
6. Turn the device off, remove the DMM from the circuit, and reconnect the power supply to the battery 1 terminal.

Power Supply Voltage Checks

Use the negative battery terminal as the ground for the DMM and measure the voltages at the locations listed in Table 3-10. Refer to Figure 3-5 on page 3-21 for the test point locations.

Table 3-10 System PCB Power Supply Voltage Checks

Test Point Location	Nominal DC Voltage
tab of CR8	+15.0 ±1.0V
TP109	−15.0 ±1.5V
tab of CR7	+18.0 ±1.8V
TP112	−25.0 ±2.0V
TP113	+5.0 ±0.5V
TP80	+2.40 ±0.05V
TP92	+6.0 ±0.3V
TP79	+5.0 ±1.0V
TP63	+2.5 ±1.0V
TP88	+2.5 ±1.0V
Note. To check these preamplifier voltages, connect the DMM to the isolated ground connection accessible on the preamp side of VSP1.	
TP13	+16.0 ±1.5V
TP14	−16.0 ±1.5V
TP12	+5.0 ±0.1V

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+12V Power Monitor Check

This test checks the low battery and power off voltage thresholds.

1. With the external power supply connected to the battery 1 receptacle, reduce the power supply output to a voltage between +10.2 and +9.7V.
2. Confirm that three beeps sound and the battery 1 low battery indicator flashes.
3. Reduce the dc power supply input to +8V and confirm that the device powers down.
4. Increase the dc power supply voltage input to +12V. Confirm that the device powers on and that the battery 1 LED illuminates steadily.
5. Repeat steps 2 through 4 for battery receptacles 2 and 3.

Output Waveform

This test checks the defibrillator output waveform.

1. Connect the patient cable to the defibrillator analyzer.
2. Place a battery in receptacle 1 and rotate the POWER switch to battery 1.
3. Rotate the ENERGY selection switch to 360J and press CHARGE. Confirm that the device reaches its fully-charged state in less than 10 seconds.
4. Confirm that a rising tone is audible during the charge cycle, and that a steady tone sounds when charging is complete.
5. Discharge the stored energy into the defibrillator analyzer.
6. Transfer the stored energy waveform from the defibrillator analyzer to the defibrillator so that it prints on the defibrillator recorder paper.
7. Confirm that the defibrillator output waveform closely resembles the waveform in Figure 3-9.

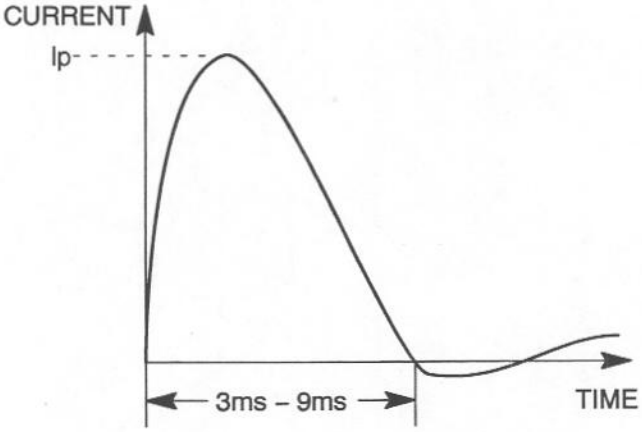

Figure 3-9 Defibrillator Output Waveform

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Pacemaker Voltage Checks

The following test points are more easily located from the top of the Chart/Pacer PCB.

1. Turn the device POWER switch to OFF and make sure that a battery is installed in the battery 1 receptacle.
2. Remove the device top cover. Detach the Chart/Pacer PCB by removing the three stand-offs that attach the Chart/Pacer PCB to the upper case (refer to page 4-21 for detailed disassembly instructions). Lower the PCB onto an anti-static pad to avoid shorting out the components on the underside.
3. Rotate the POWER switch to battery 1 and press the PACER button to turn on the pacemaker.

⚠ WARNING

Shock hazard. High voltage of +350Vdc is present at TP25 and associated circuitry. Do not allow any bodily contact with the Chart/Pacer Isolated Power Supply circuitry.

4. Use isolated ground (accessible at TP24) and measure the following voltages. Refer to Figure 3-7 on page 3-27 for the test point locations.

TP25	350 ±35Vdc
TP17	12.0 ±1.0Vdc
TP26	5.0 ±0.1Vdc
TP19	6.9 ±0.4Vdc

MIEMSS Modulator PCB Supply Voltages

1. Make sure that a battery is installed in battery receptacle 1 and rotate the POWER switch to battery 1.
2. Connect the DMM ground to P2 pin 4. Confirm that the following voltages are within tolerance. Refer to Figure 3-8 on page 3-30 for the connection locations.

U4 pin 8	+15.0 ±1.5Vdc
U4 pin 4	−15.0 ±1.5Vdc
U4 pin 5	+2.50 ±0.25Vdc

Status Display Failure Codes

Table 3-11 lists possible causes for some device failures along with the codes associated with each failure. These codes appear on the Status Display. Refer to Options Mode Selection Flow Chart (Figure 2-2 on page 2-9) for instructions on selecting failure code data while in the options mode.

Table 3-11 Status Display (Fault Stack) Failure Codes

Failure Code	Description	Possible Cause Of Failure Code
1	System microcomputer ROM failure	System microcomputer (U15)
2	System microcomputer RAM failure	System microcomputer (U15)
3	Not used	
4	Abnormal transfer occurred (not necessarily a recent failure)	a. Open air discharge b. Transfer drive circuitry
5	Pacemaker hardware failure	a. +12V or +320V pacemaker power supply b. Current delivery c. Fault sense circuitry d. Chart/Pacer microcomputer (U8)
6	Defib/ECG microcomputer (U20) self-test error	a. Defib/ECG microcomputer (U20) RAM or ROM error b. System Microcomputer (U15) c. Serial data error
	Preamp test failure	a. Preamp hybrid (U41) b. Preamp power supply c. Lead select analog switch d. Optical coupler e. Any preamp component that would corrupt a CAL pulse
7	Energy ready compare error	a. One of the high voltage dividers out-of-tolerance b. Charge Control hybrid (U24) c. Auxiliary A/D (U9) or voltage reference d. Defib/ECG microcomputer (U20) e. System microcomputer (U15) f. Serial data error
8	System watchdog error	a. Defib/ECG microcomputer (U20) b. System microcomputer (U15)
9	A/D Converter failure	A/D Converter (U9)
10	+6.67V supply out-of-tolerance	a. Excessive load on any supply b. PWM Controller (U1) c. R3 or R9 out-of-tolerance
11	+15V supply out-of-tolerance	a. Excessive load on any supply b. PWM Controller (U1) c. R3 or R9 out-of-tolerance
12	Anode supply out-of-tolerance	a. Anode Power Supply b. Jumper on AS1 Shutdown (pin 5) c. Voltage at TP80 out-of-tolerance
13	Transfer drive circuitry failure	Q26, Q27, Q13, or CR17
14*	EEROM failure	EEROM, U10 failure
15	Defib/ECG microcomputer (U20) serial data error	Defib/ECG microcomputer (U20)
16	Pacemaker serial data error	Chart/Pacer microcomputer (U8)

*If this error occurs after a new PCB has been installed, perform TCP-Defibrillator Calibration, TCP-AVAILABLE ENERGY Display, and TCP-Recorder Calibration (beginning on page 3-27); then clear the error code, perform the PIP, and check to see if the error code is gone.

Main Control Panel Keyboard Decoding

The following information is provided as an aid to troubleshooting. Table 3-12 shows the keyboard layout and the meaning of the row-column contact closures. Key closures can be simulated by momentarily connecting the indicated connector positions. For example, FREEZE can be simulated by connecting J1-37 to J1-33. The ECG SIZE and QRS VOLUME controls scroll if contact is maintained. Use an oscilloscope to determine whether the following conditions exist:

- Only one of the row signals is active at a time. The signals are "active-high."
- Column signals appear with the appropriate contact closure and coincide with the appropriate row activation.

Table 3-12 Main Control Panel Keyboard Matrix

Columns		0 (J1-35)	1 (J1-37)	2 (J1-39)	3 (J1-40)
Rows	**0 (J1-32)**	QRS VOL ▼	QRS VOL ▲	ECG SIZE ▲	ECG SIZE ▼
	1 (J1-31)	CODE SUMMARY	CAL	LEAD SELECT	
	2 (J1-33)	RECORD	FREEZE	SYNC	

Section 4

Service and Maintenance

Introduction

This section provides the following information:

- Maintenance and Testing Schedule
- Factory Modification Kit (P/N 806662)
- Battery Maintenance
- Battery Connector Pin Maintenance
- Recorder Maintenance and Service
- Special Handling Procedures for Static Sensitive Devices
- Capacitor Discharge Tool
- Disassembly Procedures
- Inspection
- Cleaning
- PCB Repair Precautions
- Tools and Materials for Cleaning and Repair
- Device Storage and Reactivation

Familiarize yourself with this section before servicing or repairing the LIFEPAK 10 defibrillator/monitor/pacemaker. For assistance in servicing or maintaining the device, contact a Physio-Control representative. In the US call 1.800.442.1142.

Maintenance and Testing Schedule

Periodic maintenance, inspection, and testing of the LIFEPAK 10 defibrillator/monitor/pacemaker and accessories are important to help detect and prevent possible electrical and mechanical problems. Table 4-1, page 4-2 presents a schedule for maintenance and testing activities for service personnel. The Performance Inspection Procedure and Test and Calibration Procedures are provided in Section 3.

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Table 4-1 Maintenance and Testing Schedule for Service Personnel

Activity	As Needed	3 Months	6 Months	12 Months	24 Months
Performance Inspection Procedure (PIP)			●		
Test and Calibration Procedures (TCP)	●				
Inspection—Exterior (defined in Table 4-2, page 4-24; activity is included with PIP)	●				
Inspection—Interior (defined in Table 4-3, page 4-25)	●				
Cleaning—Exterior (defined in Table 4-4, page 4-25)	●				
Cleaning—Interior (defined on page 4-25)	●				
Battery Reconditioning (defined in Figure 4-1, page 4-7)		●			
Battery Shelf Life Test (defined in, Figure 4-2, page 4-8 page; includes Battery Reconditioning)			●		
Battery Connector Pin Replacement (defined in Figure 4-4, page 4-12; inspection included with PIP)	●				●

Useful Life

The LIFEPAK 10 defibrillator/monitor/pacemaker and subassemblies are subjected to rigorous life testing during product development at Physio-Control Corporation. This testing, combined with the routine test and maintenance program recommended in this manual will help provide reliable operation of this device for many years.

However, because of rapid changes and advancements in technology and limited availability of older replacement parts, all modern medical devices have a limited useful life. The American Hospital Association suggests a useful life expectancy of five years for cardiac monitors, defibrillators, and external pacemakers (*Estimated Useful Lives of Depreciable Hospital Assets, Revised 1993 Edition*). Similarly, the US Army lists a five-year life expectancy for ECG monitors and an eight-year life expectancy for defibrillators (technical bulletin: *TB MED 7, Maintenance Expenditure Limits for Medical Materiel, Rev. 8 October 1993*). Physio-Control Corporation recommends that you adopt a useful life expectancy for this device of five to eight years.

Product Support Policy

In conjunction with the useful life recommendation stated above, Physio-Control Corporation will provide full technical support and replacement parts for a period of eight years from the date of shipment from our manufacturing facility. After this eight-year period, technical support and replacement parts will be provided only as available.

Factory Modification Kit (P/N 806662)

The standard LIFEPAK 10 defibrillator/monitor/pacemaker may be upgraded to use QUIK-COMBO electrodes through factory-installation of a modification kit (P/N 806662). Installation of the kit makes component changes to the System and Chart/Pacer PCB assemblies, removes the Isolated Pacer Output connector, re-routes internal wiring, and adds the QUIK-COMBO Adapter Assembly.

Use the service and test information contained in the LIFEPAK 10C defibrillator/monitor/pacemaker manual for a device which has been upgraded to use QUIK-COMBO electrodes with the modification kit (P/N 806662).

Battery Maintenance

The LIFEPAK 10 defibrillator/monitor/pacemaker uses Nickel-Cadmium (NiCad) batteries. To properly maintain NiCad batteries and to maximize battery life and performance use the Physio-Control Battery Support System (P/N 801807) or the Physio-Control Battery Support System 2 (P/N 3010035).

NiCad Battery Performance Factors

There are three major factors which affect the performance of NiCad batteries:

- Temperature
- Voltage Depression
- Self-Discharge Rate

Temperature

Charging a battery at temperatures below 20°C (68°F) or above 25.5°C (78°F) will prevent the battery from reaching its full capacity and may lead to *irreversible* cell damage.

Voltage Depression

Voltage depression is a condition that reduces battery performance, particularly when charging the defibrillator. This condition is often mistakenly called "memory." Voltage depression can usually be reversed by reconditioning the battery every 3 months as described on page 4-7. Voltage depression is caused by:

- Repeatedly attempting to add more charge to a fully-charged or a nearly fully-charged battery
- Extended charging at temperatures above the maximum recommended 25.5°C (78°F).

⚠ WARNING

Possible power failure. Using a battery affected by voltage depression may result in power failure during patient care without warning. Be sure to properly maintain batteries as described in this section.

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Self-Discharge Rate

Like most batteries, NiCad batteries self-discharge when they are not used. A new NiCad battery self-discharges approximately 1% of its capacity each day when stored at room temperature. In ten days a new NiCad battery that has not been installed in the defibrillator/monitor/pacemaker loses approximately 10% of its capacity. The self-discharge rate of the battery can be evaluated by performing a Shelf-Life Test. The actual battery self-discharge rate depends on:

- Battery age
- Temperature
- Frequency of use
- Length of time in storage
- Physical battery condition

These factors can combine to increase the battery discharge rate. For example, an older battery stored in higher temperatures may have an accelerated self-discharge rate much greater than 1% a day.

⚠ **CAUTION**

Possible battery damage. Remove and replace a battery when the low battery indicator light begins flashing. Over-discharging can shorten battery life.

Physio-Control NiCad Batteries

Use only Physio-Control batteries and battery chargers with Physio-Control devices. Use only the Physio-Control Battery Support System for battery maintenance.

⚠ **WARNING**

Possible device failure. Physio-Control has no information regarding the performance or effectiveness of its LIFEPAK defibrillators/monitors/pacemakers if they are used in conjunction with remanufactured or alternate source batteries, or with chargers from other sources. Use only Physio-Control batteries and chargers.

Any one of the Physio-Control FASTPAK, LIFEPAK 5 FASTPAK, or LIFEPAK 5 Battery Pak batteries can power the LIFEPAK 10 defibrillator/monitor/pacemaker. The batteries require different charge times:

- FASTPAK batteries charge in the Battery Support System in approximately 70 minutes
- Battery Pak batteries charge in the Battery Support System in approximately 4 1/2 hours

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Use Only the Battery Support System to Maintain Batteries

To properly maintain batteries, use the Battery Support System along with the following guidelines:

- Charge batteries at the proper temperature
- Place the Battery Support System in a proper location
- Rotate batteries
- Recondition batteries every three months
- Perform Shelf Life Test every six months

Use only the Battery Support System to maintain the FASTPAK, LIFEPAK 5 FASTPAK, and LIFEPAK 5 NiCad batteries.

⚠ WARNING

Possible battery damage. The two-well Battery Charger (Physio-Control Part Numbers 9-00284, 9-00288, and 801530) is not designed to charge FASTPAK batteries. Charging a FASTPAK battery in the two-well Battery Charger may reduce battery life and create a risk of fire or explosion. Do not charge a FASTPAK battery in the two-well Battery Charger.

The older two-well Battery Charger should not be used for maintenance because it *does not* perform all the tests required to properly evaluate battery performance.

⚠ WARNING

Possible device failure. The AC and DC Auxiliary Power Modules and Power Supplies do not maintain batteries. Use only the Battery Support System to maintain batteries. The AC and DC Auxiliary Power Modules and Power Supplies do not replace the Battery Support System.

The primary use of the AC and DC Auxiliary Power Modules and Power Supplies is to supply external power to operate the device. Both Power Modules and Power Supplies trickle-charge batteries within 24 hours, but will not perform all the procedures required to properly maintain or evaluate battery performance. For further details, refer to the Operating Instructions and Service Manual included with each Power Module/Power Supply.

Charge Batteries at the Proper Temperature

The optimum charging temperature is room temperature, or 20° to 25.5°C (68° to 78°F). Batteries charged outside room temperature may not reach full capacity even if the charge time is increased. This may lead to *irreversible* cell damage.

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Place the Battery Support System in a Proper Location

Use the following guidelines for location of the Battery Support System:

- Place in a well-ventilated area
- Keep at room temperature
- Do not place in direct sunlight
- Do not place near a heat source or an air conditioner

Rotate Batteries

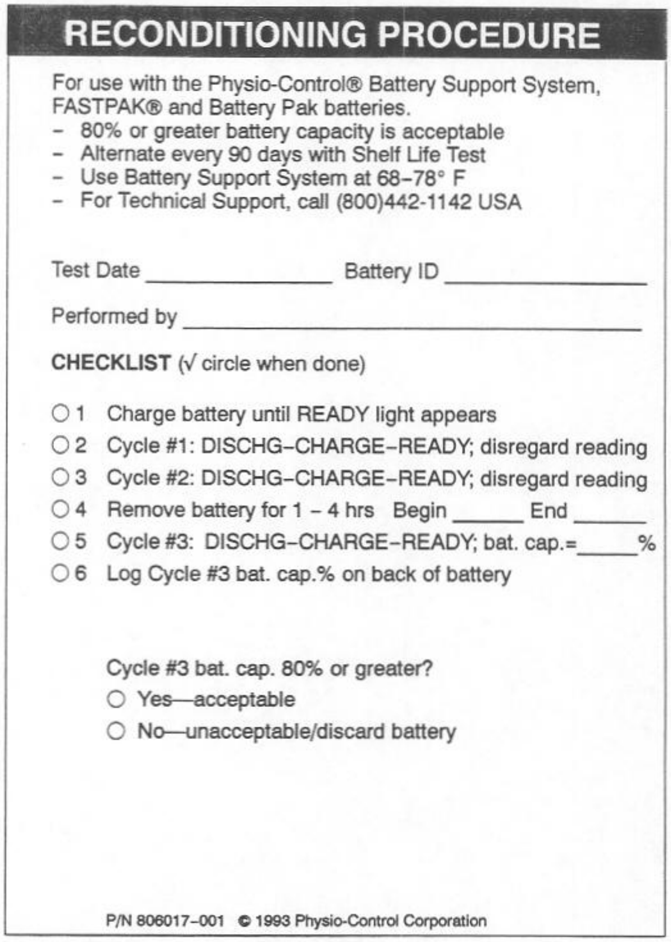
Rotate batteries so that all batteries in active service are used equally.

Reconditioning Procedure

Reconditioning is a succession of discharge/charge cycles which can be performed on a battery inserted in the far right compartment of the Battery Support System. Reconditioning a battery helps prevent or reverse the effects of voltage depression and helps keep track of battery capacity.

Perform reconditioning *every three months* according to the Reconditioning Procedure in Figure 4-1 and Figure 4-2. Discard any battery with a capacity reading of less than 80% on the third cycle. For information about ordering copies of the Reconditioning Procedure form, refer to Table 5-3, page 5-4.

84



RECONDITIONING PROCEDURE

For use with the Physio-Control® Battery Support System, FASTPAK® and Battery Pak batteries.

- 80% or greater battery capacity is acceptable
- Alternate every 90 days with Shelf Life Test
- Use Battery Support System at 68–78° F
- For Technical Support, call (800)442-1142 USA

Test Date ______________ Battery ID ________________

Performed by ____________________________________

CHECKLIST (√ circle when done)

○ 1 Charge battery until READY light appears
○ 2 Cycle #1: DISCHG–CHARGE–READY; disregard reading
○ 3 Cycle #2: DISCHG–CHARGE–READY; disregard reading
○ 4 Remove battery for 1 – 4 hrs Begin ______ End ______
○ 5 Cycle #3: DISCHG–CHARGE–READY; bat. cap.=_____%
○ 6 Log Cycle #3 bat. cap.% on back of battery

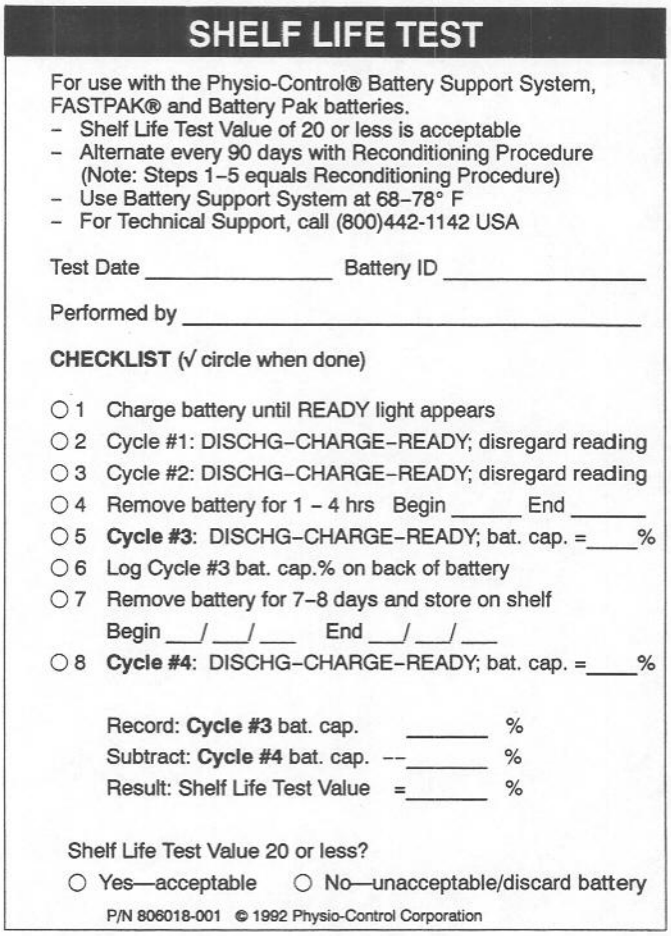
Cycle #3 bat. cap. 80% or greater?
○ Yes—acceptable
○ No—unacceptable/discard battery

P/N 806017–001 © 1993 Physio-Control Corporation

Figure 4-1 Reconditioning Procedure Form (for use with the Battery Support System only)

Shelf Life Test Procedure

The Shelf Life Test evaluates the self-discharge rate of a stored battery. Perform the Shelf Life Test described in Table 4-1 and Figure 4-2 *every six months, or alternate it with the Reconditioning Procedure in Figure 4-1 or Figure 4-2 every three months.* Discard any battery with a Shelf Life Test value of more than 20 when using the Battery Support System. For information about ordering copies of the Shelf Life Test form, refer to Table 5-3, page 5-4.



SHELF LIFE TEST

For use with the Physio-Control® Battery Support System, FASTPAK® and Battery Pak batteries.

- Shelf Life Test Value of 20 or less is acceptable
- Alternate every 90 days with Reconditioning Procedure (Note: Steps 1–5 equals Reconditioning Procedure)
- Use Battery Support System at 68–78° F
- For Technical Support, call (800)442-1142 USA

Test Date ______________ Battery ID ______________

Performed by ______________________________

CHECKLIST (√ circle when done)

○ 1 Charge battery until READY light appears
○ 2 Cycle #1: DISCHG–CHARGE–READY; disregard reading
○ 3 Cycle #2: DISCHG–CHARGE–READY; disregard reading
○ 4 Remove battery for 1 – 4 hrs Begin _____ End _____
○ 5 **Cycle #3**: DISCHG–CHARGE–READY; bat. cap. =____%
○ 6 Log Cycle #3 bat. cap.% on back of battery
○ 7 Remove battery for 7–8 days and store on shelf
Begin ___/___/___ End ___/___/___
○ 8 **Cycle #4**: DISCHG–CHARGE–READY; bat. cap. =____%

Record: **Cycle #3** bat. cap. ______ %
Subtract: **Cycle #4** bat. cap. --______ %
Result: Shelf Life Test Value =______ %

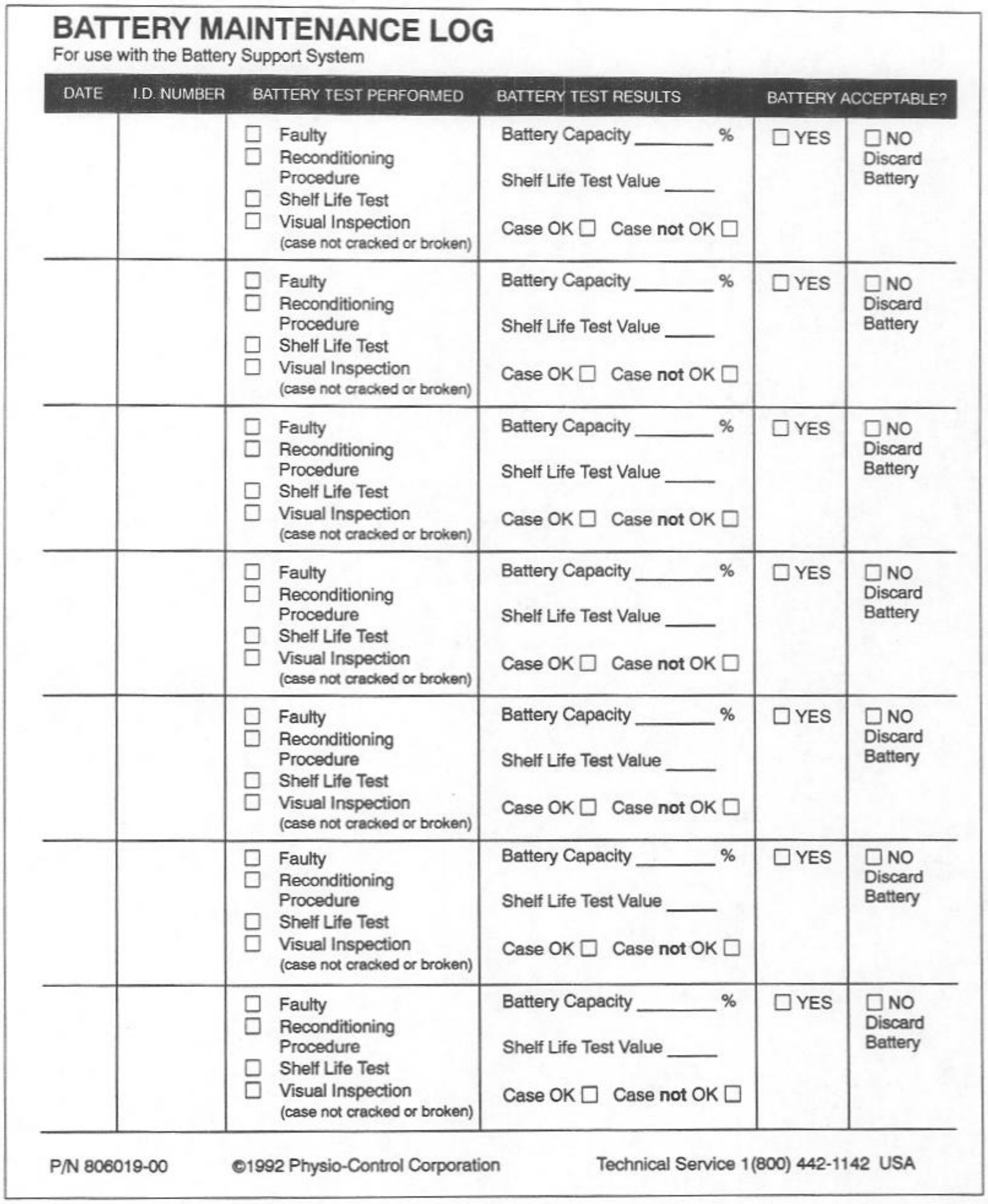
Shelf Life Test Value 20 or less?
○ Yes—acceptable ○ No—unacceptable/discard battery

P/N 806018-001 © 1992 Physio-Control Corporation

Figure 4-2 Shelf Life Test Form
(for use with the Battery Support System only)

Battery Maintenance Log

The Battery Maintenance Log shown in Figure 4-3 is available to help track battery maintenance procedures. For information about ordering copies of the Battery Maintenance Log, refer to Table 5-2, page 5-4.



BATTERY MAINTENANCE LOG

For use with the Battery Support System

DATE	I.D. NUMBER	BATTERY TEST PERFORMED	BATTERY TEST RESULTS	BATTERY ACCEPTABLE?	
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ________ % Shelf Life Test Value _____ Case OK ☐ Case **not** OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ________ % Shelf Life Test Value _____ Case OK ☐ Case **not** OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ________ % Shelf Life Test Value _____ Case OK ☐ Case **not** OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ________ % Shelf Life Test Value _____ Case OK ☐ Case **not** OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ________ % Shelf Life Test Value _____ Case OK ☐ Case **not** OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ________ % Shelf Life Test Value _____ Case OK ☐ Case **not** OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ________ % Shelf Life Test Value _____ Case OK ☐ Case **not** OK ☐	☐ YES	☐ NO Discard Battery

P/N 806019-00 ©1992 Physio-Control Corporation Technical Service 1(800) 442-1142 USA

Figure 4-3 Battery Maintenance Log

Receiving New Batteries

When receiving newly purchased batteries, promptly label and recondition each one.

Label Batteries

Label each new FASTPAK or Battery Pak with a unique identification number so that it can be easily tracked through all maintenance and rotation.

Recondition New Batteries

Because NiCad batteries self-discharge, a new battery may not be fully charged when it is first received. Recondition a newly purchased battery according to Figure 4-1 or Figure 4-2, page 4-7, and page 4-8.

Storing Batteries

Store batteries in the Battery Support System or on a shelf. While in storage, batteries require routine maintenance.

Store batteries at the proper temperature:

- Store batteries between 4.4° and 26.7°C (40° and 80°F). Cooler temperatures reduce the battery self-discharge rate
- Never freeze batteries

⚠ WARNING

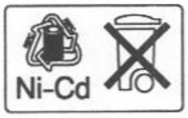
Possible device failure. Failure to charge a stored battery before returning it to active service may result in premature power failure of the defibrillator/monitor/pacemaker during patient care. Always charge a stored battery *before returning it to active service.*

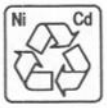
Recycling Batteries at the End of Useful Life

When properly maintained, the Physio-Control NiCad batteries should have a battery life of approximately two years. A NiCad battery has reached the end of useful life if *one or more* of the following circumstances occur:

- Battery capacity is less than 80% *after* reconditioning
- There is a difference of *greater than 20* after performing a battery Shelf Life Test
- There is physical damage to the battery case
- The Battery Support System indicates FAULTY when you try to recharge the battery

To promote awareness of battery recycling, Physio-Control NiCad batteries are marked with one of these symbols:





When a Physio-Control NiCad battery has reached the end of its useful life, recycle the battery as follows.

Battery Recycling in the US

Recycle NiCad batteries by participating with Physio-Control Corporation in a national battery recycling program. Contact your Physio-Control representative to obtain shipping instructions and battery shipping containers. Do not return your batteries to the Physio-Control Corporate Headquarters in Redmond, Washington, unless instructed to do so by your Physio-Control representative.

Battery Recycling Outside the US

Recycle NiCad batteries according to national and local regulations. Contact your local Physio-Control representative for assistance.

Installing and Removing a Battery

Do not drop or force a battery into the battery well. To install a battery, perform these steps:

⚠ WARNING

Possible loss of power during patient care. Battery pins (connectors) in the LIFEPAK 10 defibrillator/monitor/pacemaker and the Battery Support System may be damaged if the batteries are dropped or forced into battery wells. Inspect pins routinely for signs of damage.

1. Align the battery with battery well so the battery clip is toward connector pins.
2. Insert the opposite end of the battery clip into the battery well.
3. Firmly press the other end of the battery into the battery well until it clicks into place.

To remove the battery, press the battery clip and lift.

Battery Connector Pin Maintenance

As a part of routine maintenance, inspect the battery connector pins (Physio-Control Part Number 802278-02) and replace any pins which appear bent, broken, loose, corroded, worn, or damaged. Inspection of the battery connector pins is included as part of the Performance Inspection Procedure (PIP-Physical Inspection) on page 3-1. Replacement is recommended at least every 24 months.

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The pins may be replaced without opening the case. Use a 5/32-inch nut driver to unscrew the threaded shaft and remove the pin as shown in Figure 4-4. When installing a pin, make sure that the threads are properly aligned. Tighten the pin firmly, but do not overtighten.

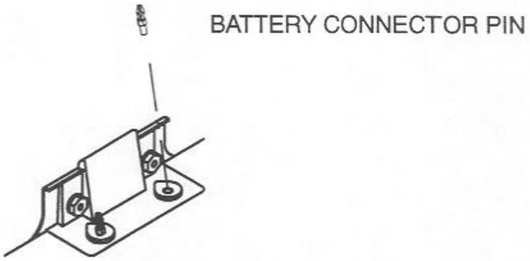

Figure 4-4 Battery Connector Pin Replacement

Recorder Maintenance

This section provides general maintenance information for the recorder used in this device. A mechanical illustration and list of parts are shown in Figure 5-10 on page 5-39. Refer to this figure to locate parts specified in these procedures. Only the listed parts are available for replacement. Other parts are shown in Figure 5-10 for reference only.

Recorder Paper Use

To protect recorder paper and recordings follow these guidelines:

- Do not apply tape or other adhesives over annotation or ECG tracing. Adhesives may be applied to the *back* of the paper.
- Store paper only in *paper* folders. Do not store in plastic folders.
- Avoid extended exposure to sunlight. Avoid temperatures over 27°C (80°F) and relative humidity over 70%.

Recorder Paper Replacement

Follow these steps to replace recorder paper:

⚠ CAUTION

Possible printhead damage. Use only Physio-Control paper (Part Number 804700) for this recorder. Do not use waxed papers.

1. Make sure recorder power is off. Pull up the slot-textured door of the recorder to expose the paper roll.
2. Remove empty paper roll.
3. Replace with new roll of recorder paper (with the paper grid facing toward the front).
4. Pull out a short length of paper and close the doors of the recorder (rear door first).

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Printhead Cleaning

Clean the printhead periodically to prevent paper debris from collecting on the printhead surface. Perform cleaning after using approximately 100 rolls of chart paper or more often if needed. Clean the printhead with a cotton swab that has been soaked in clean isopropyl alcohol.

1. Switch the device power off. Locate the printhead (refer to Figure 5-10 on page 5-39, Recorder Assembly). The printhead is positioned between the two brushes on the upper half of the recorder.
2. Wipe the surface of the printhead clean with the alcohol-soaked cotton swab, allowing only the cotton tip of the swab to contact the printhead.

Recorder Paper Sensor Cleaning

The paper sensor also requires periodic cleaning to prevent paper debris from blocking the infrared signals that reflect off the paper during normal operation. Refer to Figure 4-5 for the location of the paper sensor.

Clean the sensor whenever the printhead is cleaned. Use a clean cotton swab soaked in clean isopropyl alcohol. Gently wipe the surface of the paper sensor with the tip of the swab.

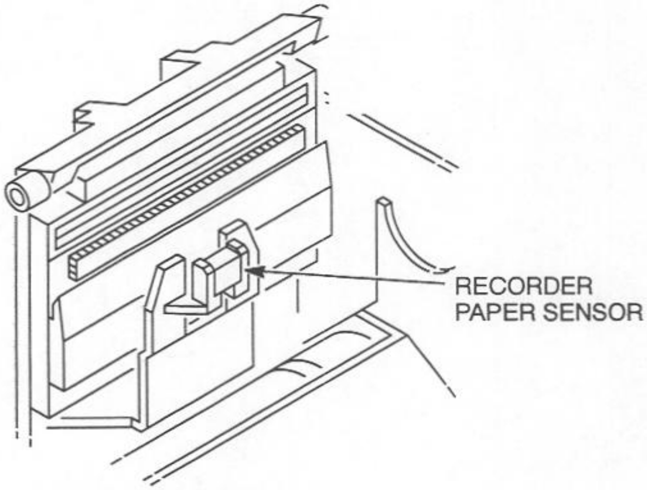

Figure 4-5 Recorder Paper Sensor Location

Printroller Cleaning

To remove paper debris and other residue from the printroller, soak a cotton swab with alcohol and wipe across the roller surface.

Printhead Adjustment Procedure

Changes in printhead's up/down alignment can cause changes in print image quality. Use the following procedure to adjust the printhead for optimal printing. Before beginning this procedure, make sure that the power is off and that there is paper in the recorder.

1. Remove the recorder from the defibrillator. (Refer to Recorder Assembly Removal, page 4-14.)

2. Connect a jumper cable between the recorder and the defibrillator and install the recorder paper.
3. Program the defibrillator to display a square waveform and run a recorder strip. (Refer to the Options Mode Selection and Programming procedure, page 2-9, and Figure 2-2.)
4. Turn off the recorder.
5. Open the recorder door and locate the pivot screw on the bottom rear surface. Using a phillips screw driver, tighten or loosen the pivot screw to adjust the printhead for optimum print image quality.
6. Close the recorder door and run another test strip to confirm print image quality. Adjust as required until optimum print quality is achieved.
7. Turn off the recorder and the defibrillator power, remove the jumper cable, and reinstall the recorder.

Recorder Service

This section provides instructions for removing and repairing the recorder. Refer to Figure 5-10 on page 5-39 for an illustration of the Recorder Assembly. Before beginning the following procedures, make sure the power is off.

Recorder Assembly Removal

Use the following procedure to remove the Recorder Assembly (A7). The Recorder Assembly may be removed without disassembling the defibrillator enclosure.

1. Open the recorder door and remove the paper roll and two screws (61) visible in the bottom of the recorder. (Discard these screws and replace them when reassembling.)
2. Close the recorder door.
3. Lift up the rear of the assembly slightly, pull the recorder out and away from the connector.

Door Assembly Removal

Follow these steps to remove the door assembly:

1. Open the door until the door-open spring bushing is exposed.
2. Using a screw driver, snap out the spring bushing from the door side.
3. Deflect out the door sides over the hubs and remove the door and spring.

Door Assembly Replacement

To replace the door assembly:

1. Insert the long leg of the door-open spring as far as possible into the hole located on the side of the recorder chassis.
2. Place the loop of the spring over the hub on the side of the recorder chassis.
3. Flex the spring and hook the spring bushing over the edge of the chassis.

4 Place the door assembly over the end of the recorder chassis and push it on until the door sides snap into place over the hubs on both sides of the recorder chassis. Make sure that the paper ejector is positioned inside the recorder chassis.

5 Using a screw driver, push the spring bushing into the hole located inside the door side wall. Make sure that the bushing is fully seated.

Motor Assembly Removal

Use the following procedure to remove the recorder motor assembly:

1 Using a knife blade or small slotted screw driver, pry out and remove the gear cover.

2 Remove the retaining ring and 31-tooth motor gear. Discard the retaining ring.

3 Remove the three flathead motor mounting screws.

4 Push out and remove the motor from the recorder chassis.

5 Pull off the motor connector tubing and remove the connector and the motor from the chassis.

Motor Assembly Replacement

To replace the recorder motor assembly:

1 Plug the motor connector into the mating connector on the recorder chassis with the black wire facing toward the chassis bottom.

Note. Reversing the black and red leads will cause the recorder to run backwards.

2 Slide the motor leads tubing fully over the connector and latch. (It may be necessary to expand the tubing with pliers before installing.) Make sure that the motor connector end is latched.

3 Install the gear end of the motor into the chassis gear hole and align the mounting holes.

4 Rotate and position the motor so that the motor leads are against the chassis center wall.

5 Install the three flat head motor mounting screws. Torque to approximately 27.5 inch-ounces. Do not over-tighten.

6 Install the 31-tooth motor gear and retaining ring. Make sure the recessed side of the gear faces out.

7 Remove the adhesive release liner on the gear cover. Install the gear cover into the recessed gear area of the recorder chassis.

Printroller Assembly Removal

Use the following procedure to remove the printroller assembly:

1 Deflect out the door flange adjacent to the printroller gear and remove the printroller, paper strippers and shaft.

2 Save the paper strippers and roller shaft for reassembly.

Printroller Assembly Replacement

To replace the printroller:

1 Place the roller shaft into the printroller assembly with the flat end opposite the printroller gear..

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2 Align and position the flat end of the roller shaft, with the installed printroller, into the door "D" hole.
3 Snap the other end of the shaft into the door hole on the gear side of the assembly. Make sure that the roller assembly and gears will rotate freely.
4 Bend and rotate the paper strippers into place. Make sure that the paper strippers fit loosely in the print roller slots. Remove and replace the printroller assembly if they do not fit loosely.

Special Handling Procedures For Static Sensitive Devices

Many electronic semiconductor devices such as MOSICs, FETs, optical isolators, or film resistors can be damaged by the discharge of static electricity. It is very common for anyone to build up static charge, especially when wearing synthetic clothes, and to transfer this charge to any object touched. Such a discharge can damage or destroy Static Sensitive Devices (SSDs). In most cases, the discharge is not even perceptible to the person at fault.

To prevent damage to SSDs due to static discharge, observe the following precautions when performing any open-case test, maintenance, or repair procedures.

Look for SSD Symbol

Note that SSDs such as PCBs are indicated in this service manual with the following warning: ⚠

Use Static-Dissipative Mat

Always perform repair or maintenance on a static-dissipative mat connected to earth ground.

Wear Wrist Strap

Always wear a conductive wrist strap connected to the mat and to ground except when working on energized equipment or when discharging high voltage circuits. The strap must be snug enough to make good contact against bare skin.

⚠ WARNING

Possible shock. Remove the wrist strap when working on energized equipment or when discharging high voltage circuits.

Transport and Store PCBs Properly

Transport and store PCBs in anti-static racks or inside conductive bags. Label the package containing the PCBs as static-sensitive.

Keep Work Area Static-Free

Keep static-generating products such as styrofoam cups or trays away from the work area. Connect all electrical equipment such as soldering irons and test equipment to ground through a three-prong plug.

Test Work Area Routinely

Test all the anti-static parts of the work area (mat, straps, cables) routinely. Keep a log of the test results.

Capacitor Discharge Tool

A Capacitor Discharge Tool can be constructed and used to discharge the storage capacitor (C1 on the LIFEPAK 10 defibrillator/monitor/pacemaker Final Assembly). The construction is illustrated in Figure 4-6. The following materials are required:

- 100kΩ, 15W resistor, high-voltage
- 5MΩ, 5W resistor, high-voltage
- Neon lamp, NE76, NE2, or NE2H
- 8AWG copper wire
- Clear plastic tubing, capable of insulating 10kV
- 10kV insulation
- RTV, silicon rubber, sealant

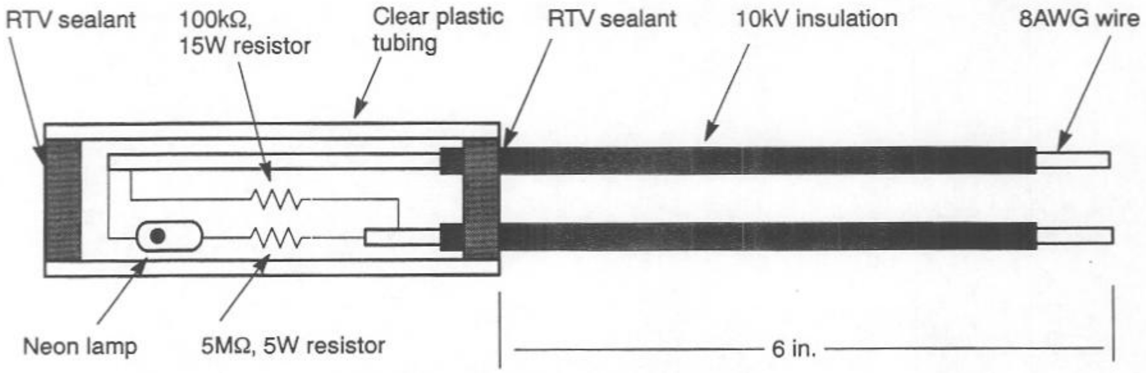

Figure 4-6 Capacitor Discharge Tool

To use the Capacitor Discharge Tool to discharge the storage capacitor:

1. Make sure all power sources (battery and Auxiliary Power Module) are removed from the defibrillator/monitor/pacemaker and the POWER switch is turned to OFF.
2. Place a Capacitor Discharge Tool probe on each storage capacitor terminal and observe the neon lamp in the handle.
3. Continue holding the probes on the terminal for at least 30 seconds after the neon lamp is no longer on.
4. While continuing to hold the probes on the terminals, connect a shorting wire across the terminals. (Be sure to remove the shorting wire from the terminals before reassembling the case and placing the device back into service.)

Disassembly Procedures

The following procedures provide instructions for disassembling the major components of LIFEPAK 10 defibrillator/monitor/pacemaker. Separate or disassemble only to the extent required. Unless otherwise stated, parenthetical numbers refer to item numbers in the Final Assembly Parts List (page 5-7) and Figure 5-1 (page 5-14). Each "P" connector mates to a "J" connector with the same number. Reassembly procedures are the reverse unless otherwise noted.

⚠ WARNING

Shock hazard. Disconnect the battery and Auxiliary Power Module (if connected) before performing the disassembly procedures.

⚠ CAUTION

Possible PCB damage. Some PCB assemblies in the device contain Static Sensitive Devices (SSDs). Follow the special handling procedures (page 4-16) to prevent static discharge and damage. Refer to Table 5-1 to identify PCB assemblies containing SSDs which are indicated by this symbol: ⚠

Note: The screws used to assemble the defibrillator/monitor/pacemaker (items 59, 61 on the Final Assembly Parts List, Figure 5-1 on page 5-19) have plastic coatings on the threads to help secure the screws. These screws can be used only once. Whenever these screws are removed, they should be discarded and replaced with the same type of thread-locking screw.

Case Disassembly

Place the LIFEPAK 10 defibrillator/monitor/pacemaker upside down on a static dissipative, grounded work surface.

1. Remove the 16 screws (61) that are accessible from the bottom of the device. Do not remove the four screws holding the Left (48) and Right (49) Bail Retainers. (Discard the 16 screws and replace when reassembling.)
2. Turn the entire device right side up, holding the case shut with both hands, with the carrying handle facing front.
3. Carefully lift the Upper Case Enclosure (13) straight up, until it clears the top of the CRT screen. When the Upper Case Enclosure is clear of obstructions, tilt it back and rest it on its rear panel.

⚠ WARNING

Shock hazard. Make sure the defibrillator storage capacitor (C1) is fully discharged before removing interior components.

4. Carefully remove the High Voltage Shield (68) and retain for later reinstallation.
5. Discharge the storage capacitor (C1). The construction and use of the Capacitor Discharge Tool is described on page 4-17.

System PCB Removal

Follow these steps to remove the System PCB Assembly:

⚠ CAUTION

Possible PCB damage. The System PCB requires special SSD handling procedures as described on page 4-16.

Note: Since the options mode settings are stored in EEROM, if you replace the System PCB (that contains the EEROM) you will lose the current options mode settings. Before removing a System PCB for replacement, be sure to enter the options mode (description begins on page 2-10) and write down the user's current options mode settings. After installing the new System PCB, be sure to enter the options mode and reenter these recorded settings.

1 Refer to Figure 4-7 and Figure 5-2 (beginning on page 5-20) for connector locations and unplug the quick disconnect connectors from the System PCB. If necessary, use small pliers to remove the following connectors:

P4 and P5	Battery Connections
P53 and P54	Paddle Cable Shields
P7	Charge Output Wire Harness (W3)
P8 and P9	Transfer Relay Drive

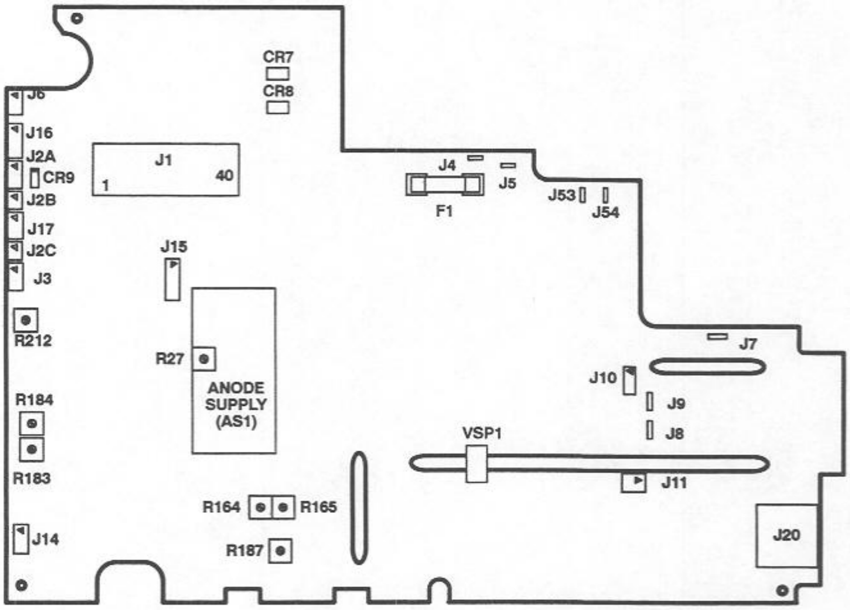
CR7
CR8
J6
J16
J2A
CR9
J2B
J17
J2C
J3
J1
1
40
J15
R212
R27
ANODE SUPPLY (AS1)
R184
R183
R164
R165
R187
J14
J4
J5
F1
J53
J54
J7
J10
J9
J8
VSP1
J11
J20

Figure 4-7 System PCB Connector Locations

2 Remove the following locking connectors from the System PCB (Refer to Figure 4-7, page 4-19, and Figure 5-2, page 5-20):

P11	QUIK-LOOK Paddles Wire Harness (W5)
P10	Relay Wire Harness (W6)
P1	Ribbon Cable to Chart/Pacer PCB
P2 A,B and C	Auxiliary Connector
P3	Battery Switch
P6	Speaker Harness
P16 and P17	Paddle Assemblies

3 Use snap-ring pliers to unscrew the black plastic nut (41) securing the patient ECG connector. Remove the O-ring seal (63) and slide up the ECG connector spacer (76) to free the ECG flex assembly at J20.

4 Remove the single screw (59) securing the System PCB to the lower case located between the ECG input connector and the preamp shield. (Discard this screw and replace it when reassembling.)

5 Grasp the CRT Assembly (A11) by its rubber front mount, and lift it and the left side of the System PCB slightly. Slide the entire System PCB/CRT assembly to the left and away from the lower case.

CRT Assembly Removal

Follow these steps to remove the CRT Assembly:

1 Remove the two screws securing the rear CRT mount to the System PCB.

2 Disconnect the deflection yoke connector at J14 and the CRT base connector at J15 (see Figure 4-7, page 4-19) from the System PCB.

3 Pull the CRT PFC Assembly (A12) out from under the top of the rubber CRT front mount so that the exposed metal of A12 is accessible.

4 Insert a small flat-blade screwdriver with an insulated handle under the CRT anode insulator and make contact with the anode connector.

5 Use a clip-lead jumper to discharge the CRT anode through the screwdriver to the CRT flex.

6 Disconnect the CRT anode connector by inserting a small flat-blade screwdriver under the anode insulator. Make firm contact with the metal of the CRT connector, and pry gently until it pulls loose. Do not try to remove the anode connector by pulling on the high voltage wire.

7 Remove and discard the two screws (59) securing the rear CRT mount to the System PCB.

8 Peel off the rubber CRT front mount, and pull the CRT loose.

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Storage Capacitor Removal

Follow these steps to remove the storage capacitor (C1):

⚠ WARNING

Shock hazard. Make sure the defibrillator storage capacitor (C1) is fully discharged before removing it.

1. Lift inductor (L1) out of its compartment, and set it on top of the Relay Assembly (A10).
2. Remove the two quick disconnect connectors from the storage capacitor (C1) terminals.
3. Cut the two large tie wraps securing the storage capacitor to the lower case. Also cut the small tie wrap that captures the battery wires to J4 and J5.
4. Lift out the storage capacitor.

Relay Assembly Removal

Follow these steps to remove the Relay Assembly:

1. Remove the four screws (59) securing the Relay Assembly (A10) to the lower case. (Discard these screws and replace them when reassembling.)
2. Cut the two tie wraps at the front of the Relay Assembly that capture some of the wires to the lower case.

   Note: Each wire connection to the Relay Assembly is permanently marked with a number that corresponds to its counterpart stamped on the body of the relay assembly. These numbers must match when reconnecting the relay assembly to the wire harness.

3. Carefully unplug the 13 quick-disconnect connectors from the relay body. If necessary, use small pliers to remove the connectors.

Chart/Pacer PCB Removal

Follow these steps to remove the Chart/Pacer PCB Assembly:

⚠ WARNING

Shock hazard. High voltage of +350V may be present at TP25 and associated circuitry on the Isolated Power Supply at the front left corner of the Chart/Pacer PCB. Short the series combination of R110 and R113 with a wire jumper prior to handling the Chart/Pacer PCB.

⚠ CAUTION

Possible PCB damage. The Chart/Pacer PCB requires special SSD handling procedures as described on page **4-16**.

1. Remove the three plastic standoffs (78) that secure the Chart/Pacer PCB (A2) to the Upper Case Enclosure (13).
2. Disconnect the pacemaker output harness at J21 (see Figure 4-8), and fold the Chart/Pacer PCB flat for servicing. Use an appropriate anti-static insulator pad under the Chart/Pacer PCB to protect it from breakage and static electricity.

3. Remove connectors J22, J23, J24, and quick disconnect ground connector J37 to remove the Chart/Pacer PCB.

Note: Be sure to remove the wire jumper across R110 and R113 when reassembling the Chart/Pacer PCB.

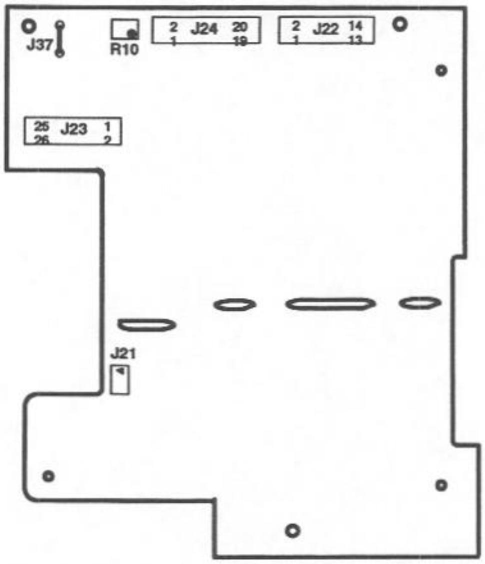

Figure 4-8 Chart/Pacer PCB Connector Locations

Optional MIEMSS Modulator Removal

Follow these steps to remove the MIEMSS Modulator PCB Assembly:

1. Cut the Tie Wrap (48) around W15
2. Disconnect W15 and W16 from the MIEMSS Modulator PCB.
3. Remove two screws (56) and remove the PCB. (Discard these screws and replace them when reassembling.)

Main Control Panel Removal

Follow these steps to remove the Main Control Panel:

1. Remove the five screws (59) securing the keypad to the Upper Case Enclosure (13). (Discard these screws and replace them when reassembling.)
2. Remove the single locking connector P27 to complete panel removal.

Status Display Module Removal

Remove the Chart/Pacer PCB (A2) before removing the Status Display Module Assembly (A9):

1. Remove the auxiliary power input line to the Power Switch (74) (quick-disconnect labeled 'A,' located in the top.
2. Disconnect connector P28 and remove the module.

Pacer Control/Battery Indicator Panel Removal

Remove the Chart/Pacer PCB (A2) before removing the Pacer Control Panel (A5).

1. Remove the auxiliary power input line to the POWER switch (80) (quick disconnect labeled A located in the top position or "12 o'clock" position on the POWER switch).
2. Remove the five screws (59) securing the Pacer Control/Battery Indicator Panel to the Upper Case Enclosure (13). (Discard these screws and replace them when reassembling.) The panel then will fold out and to the left.
3. Disconnect P26 and cut the tie wrap that retains the pacemaker cable to remove the module.

Battery Switch Removal

Follow these steps to remove the battery switch.

1. Use padded pliers to remove the POWER knob (18) by grasping firmly and pulling gently.
2. Remove the battery switch mounting nut.
3. Pull the POWER switch (80) through from the inside. Make a diagram of the locations of the quick disconnect wire terminals for reinstallation, then disconnect them.

Paddles Removal

Remove the Chart/Pacer PCB (A2) before removing the Paddles Assembly (A8).

1. Disconnect the paddle control wires from the System PCB (A1) by disconnecting J16 and J17 (see Figure 4-7, page 4-19).
2. Cut tie wraps as necessary to isolate the paddle harnesses.
3. Remove high voltage quick disconnects P49 and P51 from the relay mount (37).
4. Remove paddle cable shield connectors at J53 and J54 from the System PCB.
5. Remove wires from wire retainer on Upper Case Enclosure.
6. Pry out the coil cord retainer (54) at the paddles strain relief.
7. Push the paddles strain relief through to the outside of the device to remove the paddles. Refer to Figure 5-11, Paddle Assembly (beginning on page 5-43), to aid in further disassembly.

Upper Case Enclosure Replacement

Follow these steps to remove the Upper Case Enclosure.

1. Make sure the following assemblies have been removed: Chart/Pacer PCB, Main Control Panel, Status Display Module, Pacer Control Panel, Battery Switch, Paddles, and Recorder Assembly.
2. Remove the nut (40) retaining the auxiliary connector (part of Wire Harness W7) on the inside of the case.
3. Remove the auxiliary connector.

Front Paddle Retainer Replacement

The Front Paddle Retainer is normally welded to the Upper Case Enclosure (11). If the Front Paddle Retainer separates from the Upper Case Enclosure, reattach or replace it using the following procedure:

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1 Sand or file the original weld area so that the textured part of the Front Paddle Retainer fits flush with the top surface of the Upper Case Enclosure.

2 If the Front Paddle Retainer is a new replacement part, sand or file down the raised plastic ridges (weld area) until it is flush with the surrounding surface.

3 Apply a small amount of Sicomet 77 cyanoacrylate adhesive (P/N 201754-005) in an oval pattern on the inside vertical surface of the Front Paddle Retainer.

4 Place the Front Paddle Retainer against the Upper Case Enclosure and apply direct pressure for 30 seconds. Do not stress or disturb the bond for 30 minutes.

Inspection

When servicing or repairing the device, begin with a visual inspection. If the case must be opened during service or repair, inspect the interior. If any damage is found, inspect for other peripheral damage.

Exterior Inspection

Inspect the exterior of the case, accessories, and cables as described in Table 4-2. If physical abuse is detected, or if abuse is suspected such as dropping the case, extended exposure to extreme heat or cold, or immersion in fluids, inspect the case interior.

Table 4-2 Exterior Inspection

Items	Inspect for	Recommended Corrective Action
LIFEPAK 10 defibrillator/ monitor/pacemaker case, paddles, and accessories	Gel or foreign substances	Clean as defined in Table 4-4
	Damage or cracks, pits in paddle surfaces, improper mechanical function of controls, covers, keypads, switches, recorder door	Repair or replace
Battery pins in battery wells	Loose pins	Tighten if loose
	Bent, broken, corroded, worn, or damaged pins	Replace
Patient ECG cable, paddle cords, and other cables	Gel or foreign substances	Clean as defined in Table 4-4
	While bending and flexing cable, inspect for cracks, damage, cuts or abrasions, extreme wear, exposed inner wires, broken or bent connectors and pins; confirm connectors engage securely	Replace

Interior Inspection

Whenever the case must be opened for service or repair, inspect the interior as described in Table 4-3. If evidence of dust, dirt, or fluids is found, clean the interior as described on page 4-25. Replace parts as necessary.

Table 4-3 Interior Inspection

Items	Inspect for	Recommended Corrective Action
Chassis, covers, and brackets	Warped, bent, damaged surface, or missing hardware	Replace
Components (mechanical and electrical)	Loose mountings, broken or damaged leads, deteriorating or leaking components	Replace PCB
Connector pins (not including battery connector pins)	Bent Loose or corroded	Straighten (if slight) Replace
Flex circuits	Torn or damaged	Replace
Nameplate, labels, and decals	Illegible	Replace if damaged
PCB surfaces	Charred, cracked, or brittle **Note:** Some discoloration of PCB surface can be expected due to the high operating temperature of some components	Replace PCB
Screws and nuts	Loose or cross-threaded	Tighten or replace
Terminals and connections	Improperly installed, missing or worn	Replace or install correctly unless mounted on PCB; if PCB-mounted, replace entire PCB
Wire insulation and tubing	Deteriorated, worn, pinched, or damaged	Replace

Cleaning

Clean the exterior of the defibrillator/monitor/pacemaker, cables, and accessories as described in Table 4-4. Use only the cleaning agents listed in Table 4-4.

⚠ CAUTION

Possible equipment damage. Do not clean any part of the LIFEPAK 10 defibrillator/monitor/pacemaker or cables with bleach, bleach dilution, or phenolic compounds. Do not use abrasive cleaning agents. Do not steam, autoclave, or gas-sterilize the LIFEPAK 10 defibrillator/monitor/pacemaker or accessories unless otherwise stated in accessory Operating Instructions.

Table 4-4 Exterior Cleaning

Item	Cleaning Practice	Recommended Cleaning Agents
LIFEPAK 10 defibrillator/monitor/pacemaker case, display, paddles and cords, paddles wells, crevices, cracks, cables	Clean with damp sponge or cloth. When cleaning paddle wells, hold down pivot arm mechanism to push up paddle contacts to access for cleaning.	• Quaternary ammonium compounds • Isopropyl alcohol • Peracetic (peroxide) acid solutions
Recorder	Open doors, remove paper roll, blow dust or debris out of compartment. Clean compartment with soft *dry* cloth. Clean recorder printhead with soft *dry* cloth.	• *No cleaning agent* (only soft *dry* cloth) • *No cleaning agent* (only soft *dry* cloth)
Accessories	Refer to accessory Operating Instructions.	Refer to accessory Operating Instructions.

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PCB Repair Precautions

The LIFEPAK 10 defibrillator/monitor/pacemaker uses double-sided PCBs, multilayer PCBs and printed flex circuits.

⚠ CAUTION

> **Possible PCB assembly damage.** Improper handling can easily damage PCB assemblies beyond repair. Plated-through holes connecting the circuitry on two sides of the PCB can be damaged by too much heat.

Note: Before attempting any PCB repair, contact Physio-Control. Customer PCB repair may endanger any applicable PCB exchange agreement or other warranty.

Multilayered PCBs are not easily repaired. They consist of alternate layers of conductive patterns and insulating material bonded together and interconnected with plated-through holes. The internal layers and connection points are quickly damaged by too much heat, rendering the entire PCB useless. Therefore, it is recommended that all multilayer PCBs such as the System PCB and Chart/Pacer PCB be returned to Physio-Control for repair or replacement. Also, do not attempt to repair the CRT PFC.

Device Storage and Reactivation

The following procedures describe how to prepare the LIFEPAK 10 defibrillator/monitor/pacemaker for long term storage and how to return the device to active service after long term storage.

Preparation for Storage

Save the original shipping box and packing material for later use when shipping the device

To prepare the defibrillator for long–term storage:

1. Complete a PIP (Refer to page 3-1). Investigate and resolve any problems discovered during the PIP.
2. Remove all date-sensitive and temperature-sensitive items: (batteries, electrodes, paper, gel).
3. Package the defibrillator with it's required accessories (ECG cables, pacing cable, adapters, etc.) in the original shipping container and foam packing inserts.

   Note. For outdoor storage only: Package the defibrillator in the reusable military shipping container.
4. Mark the exterior of the storage container with the defibrillator serial number, part number, and packing date.

Device Storage Conditions

Maintain the following environmental conditions during defibrillator storage:

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1. Store the defibrillator in a cool, dry place. (Avoid places where water may accumulate.)
2. Maintain the temperature between –30 to +65°C (–22 to +149°F).
3. Stack a maximum of four cardboard shipping containers.

Periodic Inspection

Once every five years complete the device reactivation procedure described below. Repackage the defibrillator as described in the Preparation for Storage procedure outlined above.

Battery Storage Conditions

Observe the following guidelines for battery storage:

- Batteries may be stored in an uncharged state for a maximum of five years.
- Place only new, unused batteries into storage.
- Maintain a storage temperature between 0 and +35°C (+32 and +95°F). (A storage temperature between +15 to +25°C (+59 to 77°F) is preferred.)
- Do not allow batteries to freeze.

Defibrillator Reactivation

To return the defibrillator to active service:

1. Remove the device from the shipping container (save the container for later reuse).
2. Hold the device for two hours at a standby temperature between +5 to +55°C (+41 to +131°F).
3. Complete a PIP (Refer to page 3-1). Investigate and resolve any problems that arise during the PIP.
4. Replace date-sensitive and temperature-sensitive materials with fresh items (electrodes, paper, gel).
5. Insert properly maintained, fully charged batteries.
6. Complete the device readiness inventory.
7. Return the device to service.

Battery Reactivation

To return stored batteries to active service:

1. Perform the battery reconditioning procedure (refer to page 4-7).
2. Mark the battery with the reactivation date.
3. Recondition batteries every three months (see page 4-7).
4. Perform the shelf-life test procedure every six months (refer to page 4-8).

Section 5

Parts Lists and Schematics

Introduction

This section includes parts lists, component layouts or exploded views, and schematic diagrams for each major assembly of the LIFEPAK 10 defibrillator/monitor/pacemaker. The following tables are also included in this section:

- Table 5-1: Figure and page numbers of the major assemblies
- Table 5-2: Reference Designator Key
- Table 5-3: Supplies, accessories, and training tools
- Table 5-4: LIFEPAK 10 Inactive Final Assembly Part Numbers
- Table 5-5: LIFEPAK 10 Active Final Assembly Part Numbers
- Table 5-6: LIFEPAK 10 Subassembly and Component Parts List

Parts List

Use parts lists to identify *replaceable* parts. The format for each list is the same:

Ref: This column contains the reference designators or the assigned item numbers of replaceable parts. Reference designators are abbreviated (see Table 5-2) and are listed alphanumerically by this abbreviation. Assigned item numbers are listed numerically, starting with 2.

Part Number: Physio-Control Corporation part number is listed in this column. Part ordering information is provided on page 5-2.

Description: Descriptive information for a component.

Static Sensitive Devices (SSDs) are identified in this column by this symbol: ⚠ For information about proper handling of SSDs during repair or replacement, refer to page 4-16.

Used On: "Dash numbers" in this column identify a component's use on a particular LIFEPAK 10 or subassembly.

Physio-Control part numbers have a base number which identifies the generic assembly, followed by a "dash number" of two digits which identifies a unique configuration. For example: In the part number 804200-28, "804200" identifies a generic LIFEPAK 10, and "-28" identifies the domestic English language LIFEPAK 10 defibrillator/monitor with pacing.

Qty: The quantity column specifies the *total* quantity used for each part number listed.

Component Layouts or Exploded Views

Use component layouts or exploded views to locate components. The reference designator or assigned item number on the drawing corresponds to the REF column entry on the parts list.

Schematic Diagrams

Schematic diagrams show circuit function and signal flow. Signal names, pin numbers, and polarities are labeled as well as reference designators and values.

- In general, signal flow is from left to right
- Circuit names on schematics match descriptions in Section 1
- To/From labels correspond to connections shown on the interconnect diagram
- Components are shown for reference only. Not all components are available. For available components, refer to the appropriate parts list.

Part Ordering

To order parts, contact your local Physio-Control representative. In the USA, call the PARTSLINE number (1.800.442.1142). When ordering parts, provide the instrument part number and serial number located on the bottom panel of your instrument. Then specify all assembly numbers, part numbers, reference designations, and descriptions. Physio-Control Corporation may substitute different parts to reflect modifications and improvements of instrument circuitry.

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Table 5-1 Major Assemblies

Ref	Part Number	Nomenclature	Fig. No.	Page No.
	804200	LIFEPAK 10 defibrillator/monitor/pacemaker Final Assembly	5-1	5-14
		Interconnect Diagram	5-2	5-15
A1	806369	PCB Assembly with Heat sink ⚠	5-3	5-18
A2	804202	Chart/Pacer PCB Assembly ⚠	5-5	5-29
A3	804296	Anode Power Supply Assy (Part of A1) ⚠	5-6	5-34
A4	804277	Main Control Panel Assembly	5-7	5-35
A5	804196	Pacer Control/Battery Indicator Panel Assembly	5-8	5-36
A6	804258	Energy Select PCB Assy (part of A8, Sternum Paddle Assy)	5-9	5-37
A7	804189	Recorder Assembly ⚠	5-10	5-39
A8	804250	Paddle Assembly	5-11	5-43
A9	805230	Status Display Module ⚠	5-12	5-45
A10	800240	Relay Assembly	5-13	5-46
A11	806389	CRT Assembly	5-14	5-48
A12	805078	CRT PFC Assembly (part of A11)	5-15	5-48
A13	805115	Harnesses	---	5-48
A14	----	Chassis	---	5-48
A15	805608	MIEMSS Modulator PCB Assembly	5-16	5-49
W1	805115-01	Capacitor Negative-Relay Wire Harness	5-17	5-50
W2	805115-02	Capacitor Positive-Relay Wire Harness	5-18	5-50
W3	805115-00	Charger Output Wire Harness	5-19	5-51
W4	805115-14	Inductor/Relay Wire Harness	5-20	5-52
W5	805115-03	QUIK-LOOK, Apex, Sternum Wire Harness	5-21	5-53
W6	805115-04	System PCB-Relay Wire Harness	5-22	5-54
W7	805115-15	Auxiliary Power Connector-System PCB Wire Harness	5-23	5-55
W8	805115-09	Battery-Chart/Pacer PCB Wire Harness	5-24	5-56
W9	805115-10	Battery-Battery Switch-System PCB Wire Harness	5-25	5-57
W10	805115-07	Battery Switch-System PCB Wire Harness	5-26	5-58
W11	805115-21	Speaker-System PCB Wire Harness	5-27	5-58
W12	804249-00	Pacer Cable	5-28	5-59
W13	804252-01	Control Cable	5-29	5-60
W14	804253-00	Recorder Cable	5-30	5-61
W15	805628-00	System PCB-MIEMSS PCB Cable	5-31	5-62
W16	805629-01	MIEMSS PCB Output Cable	5-32	5-63

Table 5-2 Reference Designator Key

Designator	**Description**
A	Main Assemblies
C	Capacitor
CR	Diode
F	Fuse
J	PCB-mounted Jack Connector
K	Relay
L	Inductor
P	Cable-mounted Plug Connector
Q	Transistors
R	Resistor
RN	Resistor Network
RV	Varistor
S	Switch
T	Transformer
TP	Test Point
U	IC (integrated circuit)
VSP	Voltage Surge Protector
W	Wire Harness
Y	Crystal

Table 5-3 Supplies, Accessories, and Training Tools

Description	**Part Number**
FASTPAK battery	09-10424
Auxiliary Power Supply	
120 or 220Vac input	806311
12Vdc	3005494
Recorder paper, 50mm x 30m x 100ft	804700
Cables:	
Patient ECG Cable, 3-Lead	
AHA, 90° angle connector	805400-00
IEC, 90° angle connector	805400-01
AHA, straight connector	09-10418
IEC, straight connector	800947
Literature:	
LIFEPAK 10 defibrillator/monitor/pacemaker Operating Instructions	806681
LIFEPAK 10 defibrillator/monitor/pacemaker Service Manual	804271-05
Booklet *Noninvasive Pacing: What You Should Know*	805074
Booklet *Defibrillation: What You Should Know*	805662
Battery Reconditioning Procedure check sheet	806017
Battery Shelf Life Test check sheet for the Battery Support System	806018
Battery Maintenance Log check sheet for the Battery Support System	806019

Table 5-4 LIFEPAK 10 Inactive Final Assembly Part Numbers

Ref	Part Number	Description	Used On	Qty
		LIFEPAK 10 defibrillator/monitor/pacemaker (Inactive Final Assembly Part Numbers)		
	804200-00	With Pacing, English (Superceded by 804200-28)		
	804200-01	With Pacing, German (Superceded by 804200-29)		
	804200-02	With Pacing, French (Superceded by 804200-30)		
	804200-03	With Pacing, Spanish (Superceded by 804200-31)		
	804200-04	With Pacing, English International (Superceded by 804200-32)		
	804200-05	Without Pacing, English (Superceded by 804200-33)		
	804200-06	Without Pacing, German (Superceded by 804200-34)		
	804200-07	Without Pacing, French (Superceded by 804200-35)		
	804200-08	Without Pacing, Spanish (Superceded by 804200-36)		
	804200-09	Without Pacing, English International (Superceded by 804200-37)		
	804200-10	With Pacing, English CSA (Superceded by 804200-38)		
	804200-11	Without Pacing, English CSA (Superceded by 804200-39)		
	804200-12	With Pacing, French CSA (Superceded by 804200-40)		
	804200-13	Without Pacing, French CSA (Superceded by 804200-41)		
	804200-14	With Pacing, English (Superceded by 804200-28)		
	804200-15	With Pacing, German (Superceded by 804200-29)		
	804200-16	With Pacing, French (Superceded by 804200-30)		
	804200-17	With Pacing, Spanish (Superceded by 804200-31)		
	804200-18	With Pacing, English International (Superceded by 804200-32)		
	804200-19	Without Pacing, English (Superceded by 804200-33)		
	804200-20	Without Pacing, German (Superceded by 804200-34)		
	804200-21	Without Pacing, French (Superceded by 804200-35)		
	804200-22	Without Pacing, Spanish (Superceded by 804200-36)		

Table 5-4 LIFEPAK 10 Inactive Final Assembly Part Numbers *(continued)*

Ref	Part Number	Description	Used On	Qty
	804200-23	Without Pacing, English International (Superceded by 804200-37)		
	804200-24	With Pacing, English CSA (Superceded by 804200-38)		
	804200-25	Without Pacing, English CSA (Superceded by 804200-39)		
	804200-26	With Pacing, French CSA (Superceded by 804200-40)		
	804200-27	Without Pacing, French CSA (Superceded by 804200-41)		
	804200-42	Without Pacing, English MIEMSS (Retired)		
	804200-43	Without Pacing, English Military (Superceded by 804200-62)		
	804200-44	With Pacing, English International, NEMKO (Retired)		
	804200-45	With Pacing, English Outside US (Superceded by 804200-32)		
	804200-46	Without Pacing, English Outside US (Superceded by 804200-37)		
	804200-47	With Pacing, English Military (Superceded by 804200-59)		
	804200-48	Without Pacing, English International, NEMKO (Retired)		
	804200-58	With Pacing, English, MIEMSS (Retired)		

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Table 5-5 LIFEPAK 10 defibrillator/monitor/pacemaker Active Final Assembly Part Numbers

Ref	Part Number	Description	Used On	Qty
		LIFEPAK 10 defibrillator/monitor/pacemaker (Active Final Assembly Part Numbers)		
	804200-28	With Pacing, English (Replaces 804200-00, 804200-14)		
	804200-29	With Pacing, German (Replaces 804200-01, 804200-15)		
	804200-30	With Pacing, French (Replaces 804200-02, 804200-16)		
	804200-31	With Pacing, Spanish (Replaces 804200-03, 804200-17)		
	804200-32	With Pacing, English International (Replaces 804200-04, 804200-18)		
	804200-33	Without Pacing, English (Replaces 804200-05, 804200-19)		
	804200-34	Without Pacing, German (Replaces 804200-06, 804200-20)		
	804200-35	Without Pacing, French (Replaces 804200-07, 804200-21)		
	804200-36	Without Pacing, Spanish (Replaces 804200-08, 804200-22)		
	804200-37	Without Pacing, English International (Replaces 804200-09, 804200-23)		
	804200-38	With Pacing, English, CSA (Replaces 804200-10, 804200-24)		
	804200-39	Without Pacing, English, CSA (Replaces 804200-11, 804200-25)		
	804200-40	With Pacing, French, CSA (Replaces 804200-12, 804200-26)		
	804200-41	Without Pacing, French, CSA (Replaces 804200-13, 804200-27)		
	804200-59	With Pacing, English, Military-AFFC (Replaces 804200-47)		
	804200-62	Without Pacing, English, Military (Replaces 804200-43)		
	804200-63	With Pacing, English, Military, CSA		
	804200-66	With Pacing, Polish		

Table 5-6 LIFEPAK 10 Subassembly and Component Parts List (Refer to Figure 5-1)

Ref	Part Number	Description	Used On	Qty
		Subassembly and Component Parts List Used On 804200		
A1	804204	**System PCB Assembly** (Part of 806369)		
	806369-09	**System PCB Assembly**, LP10C, CRT Mounted ⚠ (Replaces 804204)	804200-28 thru 41, 66	1
	806369-13	**System PCB Assembly**, Military, CRT Mounted ⚠	804200-59, 62, 63	1
A2	804202-22	**Chart PCB Assembly** ⚠	-33 thru 37, 39, 41	1
	804202-23	**Chart/Pacer PCB Assembly** ⚠	-28 thru 32, 38, 40	1
	804202-20	**Chart/Pacer PCB Assembly**, Military ⚠	-59, 63	1
	804202-17	**Chart/Pacer PCB Assembly**, S/W ⚠	-66	1
	804202-21	**Chart PCB Assembly**, Military ⚠	-62	1
A3	804296-05	**Anode Power Supply Assembly** (Part of A1, 806369-09, 13) ⚠		1
A4	804277-05	**Main Control Panel Assembly**, French	-30, 35, 40, 41	1
	804277-06	**Main Control Panel Assembly**, German	-29, 34	1
	804277-07	**Main Control Panel Assembly**, Spanish	-31, 36	1
	804277-08	**Main Control Panel Assembly**, English	-28, 32, 33, 37, 38, 39, 59, 62, 63	1
	804277-09	**Main Control Panel Assembly**, Polish	-66	1
A5	804196-16	**Panel Assembly Indicator**, Battery (No Pacer)	-33 thru 37, 39, 41, 62	1
	804196-17	**Panel Assembly Indicator**, Battery (No Pacer)	-28, 38, 59, 63	1
	804196-18	**Pacer Control Panel Assembly**, French	-30, 40	1
	804196-19	**Pacer Control Panel Assembly**, German	-29	1
	804196-20	**Pacer Control Panel Assembly**, Spanish	-31	1
	804196-21	**Pacer Control Panel Assembly**, English International	-32	1
	804196-22	**Pacer Control Panel Assembly**, Polish	-66	1
A6	804258-02	**Energy Select PCB Assembly** (Not shown. Part of A8, 804250-11 thru 20)		1
A7	804189-00	**Recorder Assembly** ⚠	-28 thru 41, 59, 62, 63, 66	1
A8	804250-11	**Paddle Assembly**, Sternum, English	-28, 33, 59, 62, 63	1
	804250-12	**Paddle Assembly**, Apex, English	-28, 33, 59, 62, 63	1
	804250-13	**Paddle Assembly**, Sternum, French	-30, 35, 40, 41	1
	804250-14	**Paddle Assembly**, Apex, French	-30, 35, 40, 41	1
	804250-15	**Paddle Assembly**, Sternum, German	-29, 34	1
	804250-16	**Paddle Assembly**, Apex, German	-29, 34	1
	804250-17	**Paddle Assembly**, Sternum, Spanish	-31, 36	1
	804250-18	**Paddle Assembly**, Apex, Spanish	-31, 36	1
	804250-19	**Paddle Assembly**, Sternum, English International	-32, 37, 38, 39	1

Table 5-6 LIFEPAK 10 Subassembly and Component Parts List (Refer to Figure 5-1) *(continued)*

Ref	Part Number	Description	Used On	Qty
	804250-20	**Paddle Assembly**, Apex, English International	-32, 37, 38, 39	1
	804250-23	**Paddle Assembly**, Sternum, Polish	-66	1
	804250-24	**Paddle Assembly**, Apex, Polish	-66	1
A9	805230-01	**Status Display Module** ⚠	-28 thru 41, 59, 62, 63, 66	1
A10	800240-16	**Relay Assembly** (Not Repairable)	-28 thru 41, 59, 62, 63, 66	1
A11	806389-01	**CRT Assembly** (Part of A1, 806369-09, 13)		1
A12	805078-01	**CRT PFC Assembly** (Part of A11, 806389-01)		1
A15	805608-01	**MIEMSS Modulator PCB Assembly**	-42, 48	1
C1	804285-02	**Capacitor**, Energy Storage	-28 thru 41, 56, 59, 62, 63, 66	1
W1	805115-01	**Capacitor Negative-Relay Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W2	805115-02	**Capacitor Positive-Relay Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W3	805115-00	**Charger Input Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W4	805115-14	**Inductor-Relay Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W5	805115-03	**QUIK-LOOK Apex and Sternum Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W6	805115-04	**System PCB-Relay High Voltage Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W7	805115-15	**Auxiliary Power Connector-System PCB Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W8	805115-09	**Battery-Chart/Pacer PCB Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W9	805115-10	**Battery-Battery Switch-System PCB Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W10	805115-07	**Battery Switch-System PCB Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W11	805115-21	**Speaker-System PCB Wire Harness**	-28 thru 41, 59, 62, 63, 66	1
W12	804249-00	**Pacer Cable**	-28 thru 41, 59, 62, 63, 66	1
W13	804252-01	**Control Cable**	-28 thru 41, 59, 62, 63, 66	1
W14	804253-00	**Recorder Cable**	-28 thru 41, 59, 62, 63, 66	1
W15	805628-00	**System PCB-MIEMSS Modulator Cable**	-42, 48	1
W16	805629-01	**MIEMSS Output Cable**	-42, 48	1
2	804966-01	**Adhesive**, Speaker	-28 thru 41, 59, 62, 63, 66	A/R
3	804240-01	**Bail**	-28 thru 41, 59, 62, 63, 66	1
4	9-10424-17, 18, 19	**Battery**, Fastpak	-28 thru 41, 59, 62, 63, 66	1 - 3
5	804297-01	**Bezel**, Main, Control Panel (Not Shown)	-28 thru 41, 59, 62, 63, 66	1
6	805072-02	**Bezel**, Pacer, Control Panel	-28 thru 32, 38, 40, 59, 63, 66	1
7	805072-01	**Bezel**, Pacer, Cover (Not shown)	-33 thru 37, 39, 41, 62	1
8	805631-00	**Bracket**, Mounting, Lower	-42, 48	1
9	805632-00	**Bracket**, Mounting, Upper	-42, 48	1

Table 5-6 LIFEPAK 10 Subassembly and Component Parts List (Refer to Figure 5-1) *(continued)*

Ref	Part Number	Description	Used On	Qty
10	804194-00	**Cover**, Cap Mount	-28 thru 41, 59, 62, 63, 66	2
11	802278-02	**Connector**, Plug, Banana, Mini, No Solder, .218L (Used on J31-36)	-28 thru 41, 59, 62, 63, 66	6
12	804191-04	**Enclosure**, Lower Case	-28 thru 41, 59, 62, 63, 66	1
13	806668-00	**Enclosure**, Upper Case	-28 thru 41, 59, 62, 63, 66	1
14	202250-003	**Filter**, EMI, Snap-on Cable, Ferrite	-59, 62, 63	1
	202250-005	**Filter**, EMI, Snap-on Cable, Ferrite	-28 thru 41, 66	1
15	802885-00	**Foot**, Mounting	-28 thru 41, 59, 62, 63, 66	4
16	805122-03	**Housing**, Pacing Connector, Plug, White	-33 thru 37, 39, 41, 62	1
17	202196-000	**Insulator**, Transistor, White, 2015-54	-28 thru 41, 59, 62, 63, 66	1
18	804229-09	**Knob**, Battery Switch, With Insert	-28 thru 41, 59, 62, 63, 66	1
19	804261-02	**Label**, Auxiliary Power Connector, Domestic	-28, 33, 59, 62, 63	1
	804261-03	**Label**, Auxiliary Power Connector, International	-29, 30, 31, 32, 34 thru 41, 66	1
20	3009279-00	**Label**, Caution, Battery, CSA	-63	1
21	804193-08	**Label**, Display Panel, English	-28, 32, 33, 37, 38, 39, 59, 62, 63	1
	804193-09	**Label**, Display Panel, French	-30, 35, 40, 41	1
	804193-10	**Label**, Display Panel, German	-29, 34	1
	804193-12	**Label**, Display Panel, Spanish	-31, 36	1
	804193-27	**Label**, Display Panel, Polish	-66	1
22	805027-00	**Label**, ECG Connector, English	-28, 32, 33, 37, 38, 39, 59, 62, 63	1
	805027-01	**Label**, ECG Connector, French	-30, 35, 40, 41	1
	805027-02	**Label**, ECG Connector, German	-29, 34	1
	805027-03	**Label**, ECG Connector, Spanish	-31, 36	1
	805027-06	**Label**, ECG Connector, Polish	-66	1
23	805018-12	**Label**, Operating Instructions, English	-28, 32, 33, 37, 38, 39, 59, 62, 63	1
	805018-13	**Label**, Operating Instructions, French	-30, 35, 40, 41	1
	805018-14	**Label**, Operating Instructions, German	-29, 34	1
	805018-15	**Label**, Operating Instructions, Spanish	-31, 36	1
	805018-33	**Label**, Operating Instructions, Polish	-66	1
24	804446-00	**Label**, Pacer LED Cover	-28 thru 32, 38, 40, 59, 63, 66	2
25	805017-05	**Label**, Pacing Connector, English	-28, 59, 63	1
	805017-06	**Label**, Pacing Connector, English IEC	-32, 36, 37, 38	1
	805017-07	**Label**, Pacing Connector, French	-30, 40	1
	805017-08	**Label**, Pacing Connector, German	-29	1
	805017-09	**Label**, Pacing Connector, Spanish	-31	1
	805017-10	**Label**, Pacing Connector, Polish	-66	1
26	803785-00	**Label**, Physiological Effects, CSA	-38 thru 41, 63	1

Table 5-6 LIFEPAK 10 Subassembly and Component Parts List (Refer to Figure 5-1) *(continued)*

Ref	Part Number	Description	Used On	Qty
27	804264-04	**Label**, Power Select, English	-28, 33, 37, 38, 39, 59, 62, 63	1
	804264-05	**Label**, Power Select, French	-30, 35, 40, 41	1
	804264-06	**Label**, Power Select, German	-29, 34	1
	804264-07	**Label**, Power Select, Spanish	-31, 36	1
	804264-08	**Label**, Power Select, English International	-32, 37	1
	804264-12	**Label**, Power Select, Polish	-66	1
28	804260-56	**Label**, Serial Number, LP10	-28 thru 41	1
	804260-58	**Label**, Serial Number, LP10	-59, 62	1
	804260-07	**Label**, Serial Number, LP10	-63	1
	804260-56	**Label**, Serial Number, LP10	-66	1
29	800943-09	**Label**, Symbol, International, High Voltage (Not shown, used on A10)	-28 thru 41, 59, 62, 63, 66	1
30	801517-04	**Label**, UL (Not shown, used on item 12)	-28, 33	1
31	804251-00	**Label**, Warning/Danger, Domestic	-28, 33, 59, 62	1
	804251-02	**Label**, Warning/Danger, French	-30, 35	1
	804251-05	**Label**, Warning/Danger, German	-29, 34	1
	804251-04	**Label**, Warning/Danger, Spanish	-31, 36	1
	804251-06	**Label**, Warning/Danger, CSA	-32, 37 thru 41, 63	1
	804251-10	**Label**, Warning/Danger, Polish	-66	1
32	805335-00	**Label**, Warning Electrical Hazard	-32, 37	1
33	805673-00	**Label**, Warning, Pace, French	-30	1
34	804266-02	**Label**, Warning, Shock, Domestic	-28, 33, 59, 62, 63	1
	804266-01	**Label**, Warning, Shock, International	-29 thru 32, 34 thru 41, 66	1
35	805139-02	**Module**, Pacing Connector	-28 thru 32, 38, 40, 59, 63, 66	1
36	804236-01	**Mount,** CRT, Front	-28 thru 41, 59, 62, 63	1
37	804238-01	**Mount,** Relay	-28 thru 41, 59, 62, 63, 66	1
38	201508-000	**Nut**, Lock, Carbon Steel, KEP, #4-40	-28 thru 41, 59, 62, 63, 66	21
39	200805-000	**Nut**, Lock, Stainless Steel	-42, 48	1
40	805079-01	**Nut**, Seal, Auxiliary Connector	-28 thru 41, 59, 62, 63, 66	1
41	805704-01	**Nut**, Threaded Connector, ECG	-28 thru 41, 59, 62, 63, 66	1
42	804255-00	**Pad,** Adhesive, Main Bezel	-28 thru 41, 59, 62, 63, 66	1
43	805071-00	**Pad,** Adhesive, Pacer Bezel	-28 thru 41, 59, 62, 63, 66	1
44	805087-01	**Plate**, Latch, With studs	-28 thru 41, 59, 62, 63, 66	3
45	200792-002	**Plug,** Pole, Tubing, Polyethylene, Black	-66	1
46	202186-000	**Plug,** Potentiometer Access, Black, #1138-36024	-28 thru 41, 59, 62, 63, 66	1
47	800516-02	**Resistor,** Defibrillator (R1, Not shown, used on C1, Energy Storage Capacitor)	-28 thru 41, 59, 62, 63, 66	1
48	804241-05	**Retainer**, Bail, Left	-28 thru 41, 59, 62, 63, 66	1
49	804241-04	**Retainer**, Bail, Right	-28 thru 41, 59, 62, 63, 66	1
50	805117-01	**Retainer**, Cable, Control	-28 thru 41, 59, 62, 63, 66	1

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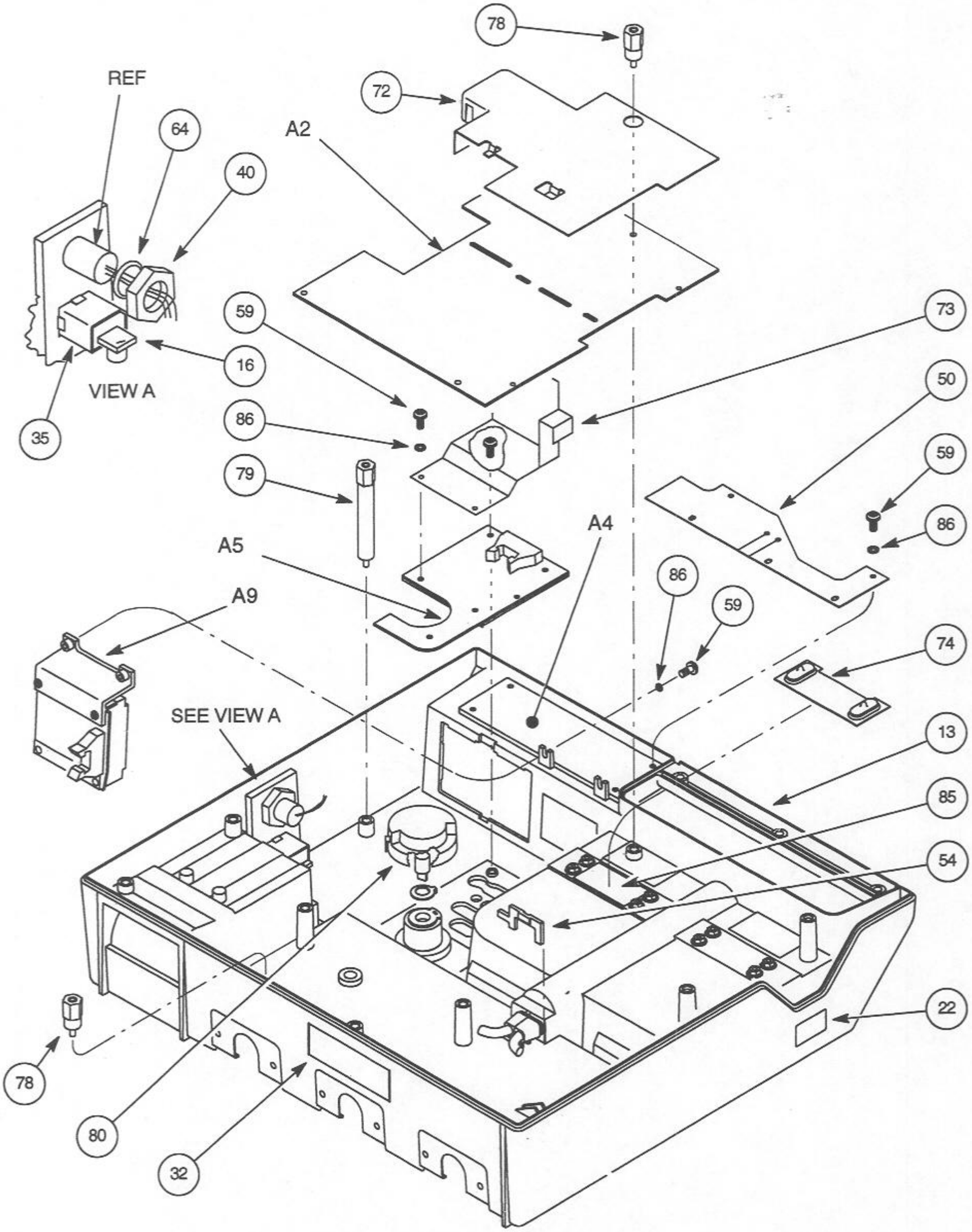
Table 5-6 LIFEPAK 10 Subassembly and Component Parts List (Refer to Figure 5-1) *(continued)*

Ref	Part Number	Description	Used On	Qty
51	200536-009	**Retainer**, Cable Tie, Nylon, .10 W x 4.06L	-28 thru 42, 48, 59, 62, 63	27
52	201472-003	**Retainer**, Cable Tie, Nylon	-42, 48	1
53	200536-011	**Retainer**, Cable Tie, Nylon, .35 W x 20.90L	-28 thru 41, 59, 62, 63, 66	2
54	804239-02	**Retainer**, Coil Cord	-28 thru 41, 59, 62, 63, 66	1
55	805710-00	**Retainer**, Connector, ECG	-28 thru 41, 59, 62, 63, 66	1
56	804448-03	**Retainer**, D-Connector (Not shown, used on J18)	-28 thru 41, 59, 62, 63, 66	1
57	804192-01	**Retainer**, Paddle, Front (this part normally welded to Upper Case Enclosure, but may be purchased and replaced separately)	-28 thru 41, 59, 62, 63	2
58	804256-03	**Retainer**, Paddle, Rear	-28 thru 41, 59, 62, 63, 66	2
59	202253-536	**Screw**, Pan Head, Nylok, 4-40 x .25L	-28 thru 41, 59, 62, 63, 66	23
60	202253-537	**Screw**, Pan Head, Nylok, 4-40 x .31L	-42, 48	2
61	202253-570	**Screw**, Pan Head, Nylok, 6-32 x .375L	-28 thru 41, 59, 62, 63, 66	22
	202253-570	**Screw**, Pan Head, Nylok, 6-32 x .375L	-42, 48	1
62	200476-769	**Screw**, Pan Head, 4-40 x .812L	-42, 48	1
62	804244-00	**Seal,** D-Connector	-28 thru 41, 59, 62, 63, 66	1
63	201209-023	**Seal**, O-Ring, Elastomeric, ECG	-28 thru 41, 59, 62, 63, 66	1
64	200060-011	**Seal,** O-Ring, Silicone, .551 ID	-28 thru 41, 59, 62, 63, 66	1
65	200060-013	**Seal,** O-Ring	-28 thru 41, 59, 62, 63, 66	1
66	805140-01	**Seal**, Pacing Connector Module	-28 thru 41, 59, 62, 63, 66	1
67	804234-00	**Seal,** Perimeter (Used on Upper Case Enclosure)	-28 thru 41, 59, 62, 63, 66	1
68	804259-02	**Shield,** High Voltage	-28 thru 41, 59, 62, 63, 66	1
69	804287-01	**Shield,** Implosion	-28 thru 41, 59, 62, 63, 66	1
70	805543-00	**Shield**, Capacitor, Cover	-28 thru 41, 59, 62, 63, 66	1
71	805542-00	**Shield**, Capacitor, End	-28 thru 41, 59, 62, 63, 66	1
72	804233-03	**Shield**, Pacer, Lower	-28 thru 41, 59, 62, 63, 66	1
73	804232-02	**Shield**, Pacer, Upper	-28 thru 32, 38, 40, 59, 63, 66	1
74	805147-00	**Shield**, Paddle Retainer	-28 thru 41, 59, 62, 63, 66	1
75	806393-01	**Sleeve**, Pacing Connector	-28 thru 32, 38, 40, 59, 63, 66	1
76	806413-00	**Spacer**, Connector, ECG	-28 thru 41, 59, 62, 63, 66	1
77	804447-06	**Spacer**, Foam, Speaker, .65D x .25T	-28 thru 41, 59, 62, 63, 66	3
78	804205-00	**Standoff**, Spacer, M/F, Molded, .798L	-28 thru 41, 59, 62, 63, 66	5
79	804205-01	**Standoff**, Spacer, M/F, Molded, 2.850L	-28 thru 41, 59, 62, 63, 66	1
80	804209-01	**Switch,** Battery Select (POWER)	-28 thru 41, 59, 62, 63, 66	1
81	201765-008	**Tape,** Adhesive, Foam, 1.0W x .25T (Not shown)	-28 thru 41, 59, 62, 63, 66	A/R
82	201765-017	**Tape,** Adhesive, Foam, 1.0W x .062T (Not shown)	-28 thru 41, 59, 62, 63, 66	A/R
83	201501-007	**Tape,** Adhesive, Foam, Poron, .75W x .45T (Not shown)	-59, 62, 63	A/R
84	806418-00	**Tape,** Adhesive, Foam, Poron, 1.0W x .312T (Not shown)	-28 thru 41, 59, 62, 63, 66	A/R

Table 5-6 LIFEPAK 10 Subassembly and Component Parts List (Refer to Figure 5-1) *(continued)*

Ref	Part Number	Description	Used On	Qty
85	202446-000	**Tape**, Double-sided	-28 thru 41, 59, 62, 63, 66	A/R
86	200804-015	**Washer,** Flat, #4 x .317OD x .016T	-28 thru 32, 38, 40, 59, 62, 63, 66	14
	200804-015	**Washer,** Flat, #4 x .317OD x .016T	-33 thru 37, 39, 41	12
87	200804-016	**Washer**, Flat, #4 x .317 OD x .03T (Used with A10, 800240-16)	-28 thru 41, 59, 62, 63, 66	4
88	200144-042	**Washer**, Flat, Insulating	-42, 48	2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79
59
86
A4
A5
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59
A9
74
SEE VIEW A
13
85
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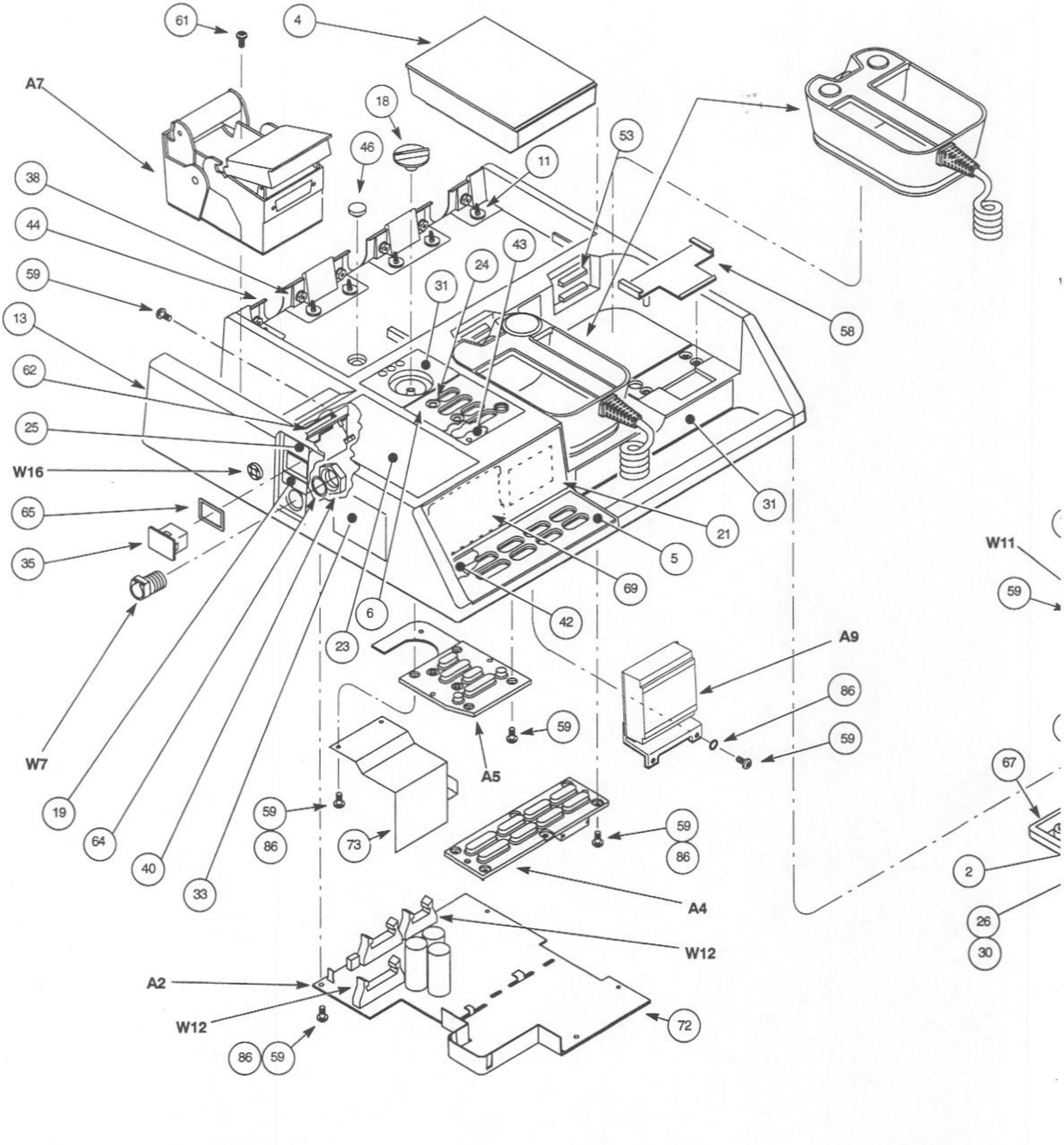
BOTTOM VIEW
OF UPPER CASE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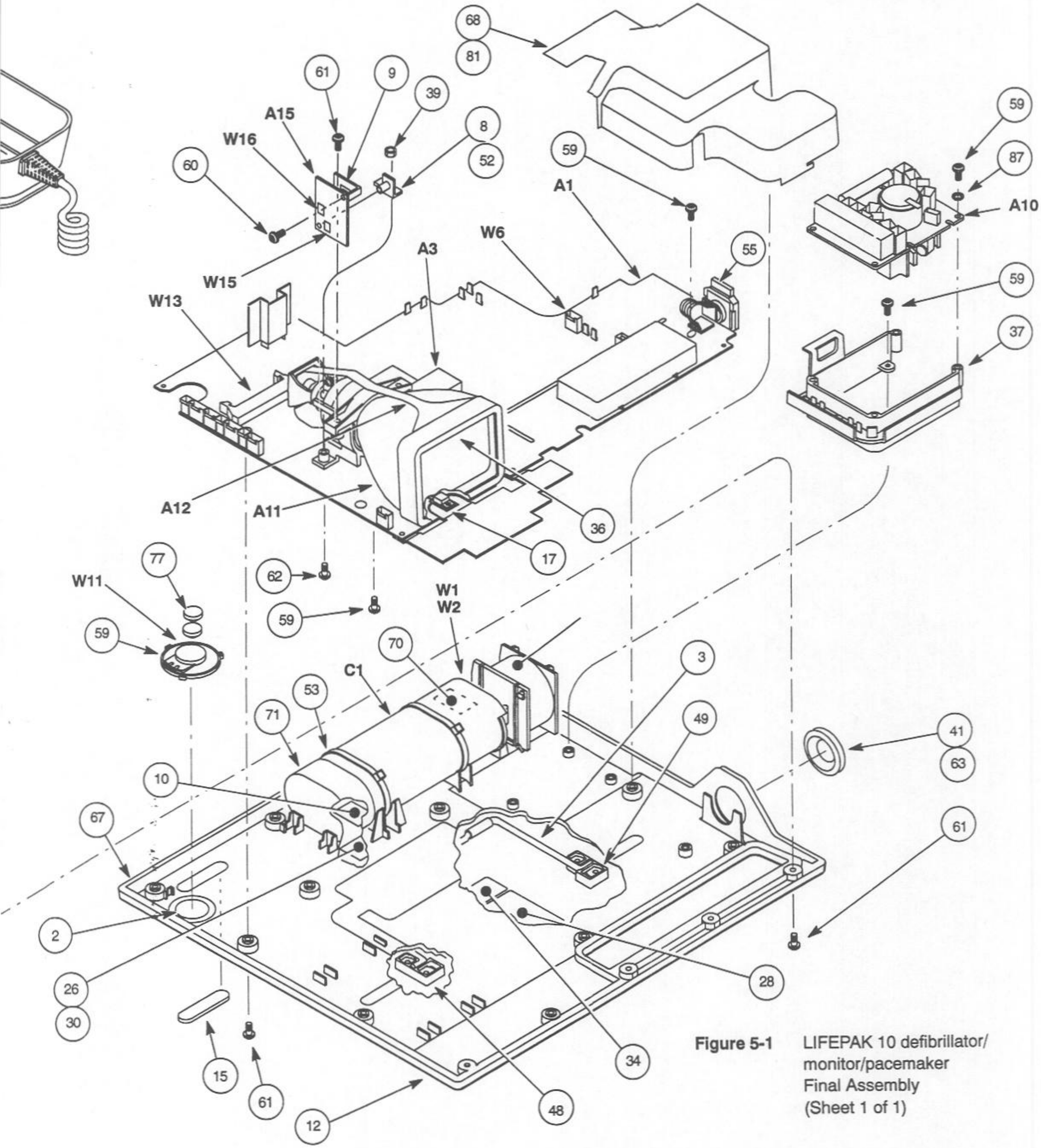
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A15
W16
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87
A10
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A3
W15
W13
A12
A11
36
17
77
W11
62
59
W1
W2
59
70
C1
3
53
71
49
41
63
10
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Figure 5-1 LIFEPAK 10 defibrillator/monitor/pacemaker Final Assembly (Sheet 1 of 1)

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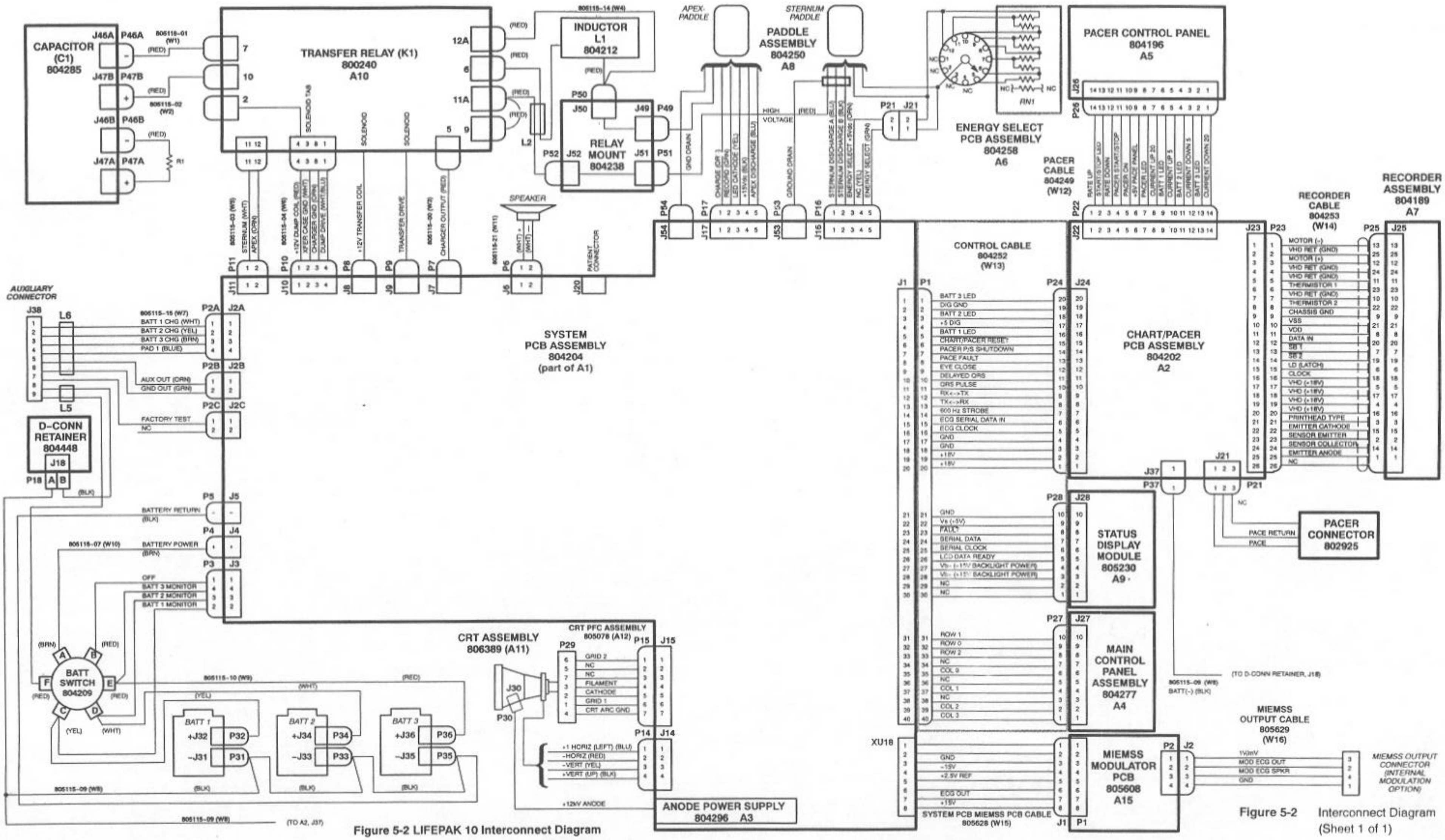
CAPACITOR (C1) 804285
TRANSFER RELAY (K1) 800240 A10
INDUCTOR L1 804212
RELAY MOUNT 804238
APEX PADDLE
STERNUM PADDLE
PADDLE ASSEMBLY 804250 A8
ENERGY SELECT PCB ASSEMBLY 804258 A6
RN1
PACER CONTROL PANEL 804196 A5
PACER CABLE 804249 (W12)
RECORDER CABLE 804253 (W14)
RECORDER ASSEMBLY 804189 A7
SPEAKER
PATIENT CONNECTOR
AUXILIARY CONNECTOR
D-CONN RETAINER 804448
SYSTEM PCB ASSEMBLY 804204 (part of A1)
CONTROL CABLE 804252 (W13)
CHART/PACER PCB ASSEMBLY 804202 A2
PACER CONNECTOR 802925
STATUS DISPLAY MODULE 805230 A9
MAIN CONTROL PANEL ASSEMBLY 804277 A4
MIEMSS MODULATOR PCB 805608 A15
MIEMSS OUTPUT CABLE 805629 (W16)
MIEMSS OUTPUT CONNECTOR (INTERNAL MODULATION OPTION)
SYSTEM PCB MIEMSS PCB CABLE 805628 (W15)
CRT ASSEMBLY 806389 (A11)
CRT PFC ASSEMBLY 805078 (A12)
ANODE POWER SUPPLY 804296 A3
BATT SWITCH 804209
BATT 1
BATT 2
BATT 3
(TO A2, J37)
(TO D-CONN RETAINER, J18)

Figure 5-2 LIFEPAK 10 Interconnect Diagram

Figure 5-2 Interconnect Diagram (Sheet 1 of 1)

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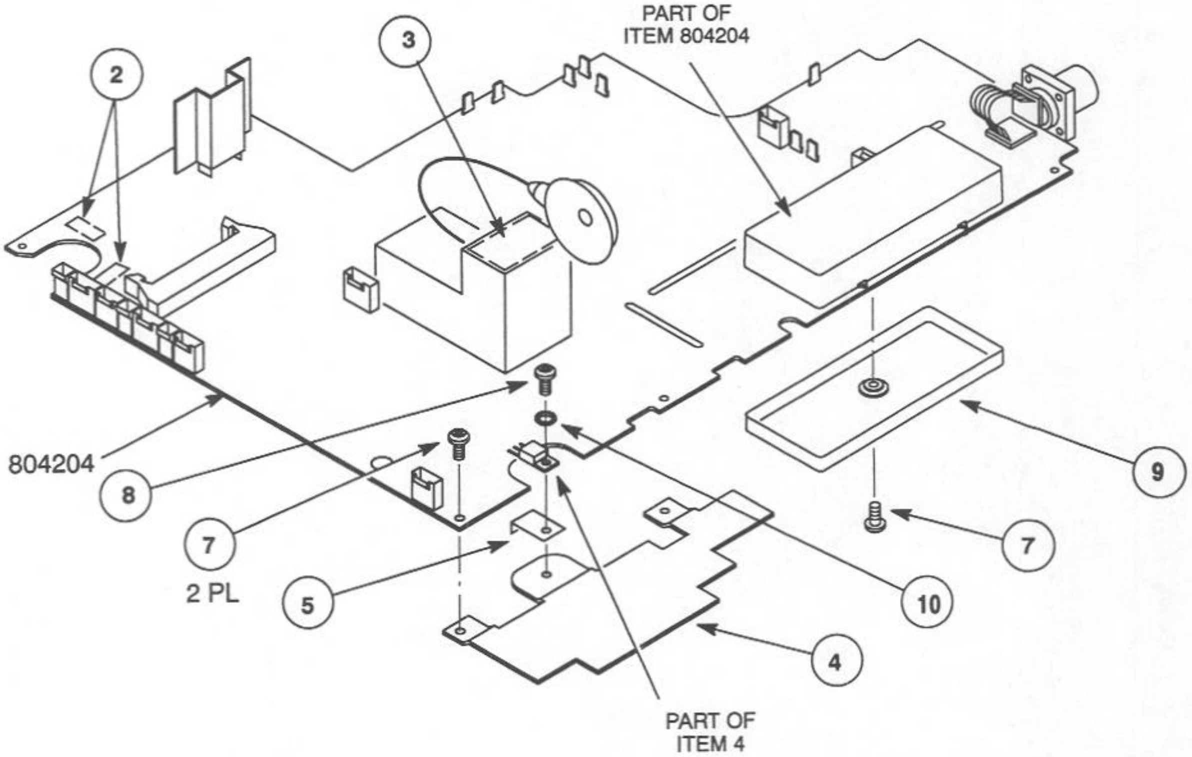
5-3 Ref	Part Number	Description	Used On	Qty
A1	806369-09	**System PCB Assembly**, LP10, CRT Mounted ⚠	804200-28 thru 41, 66	–
	806369-13	**System PCB Assembly**, LP10, CRT Mounted, Military ⚠	804200-59, 62, 63	–
		Replaceable Components:		
	806369-10	**PCB Assembly**, Heat Sink Mounted, LP10/LP10C	806369-09	1
	806369-14	**PCB Assembly**, Heat Sink Mounted, Military	806369-13	1
	804204-18	**PCB Assembly**, System, LP10/LP10C	806369-10	1
	804204-22	**PCB Assembly**, System, Military AFFC, LP10	806369-14	1
CR1,2	200971-000	**Diode**, 1N914B, 8ns, PIV 75	-10, 14	24
CR4	202136-003	**Diode**, UF4004	-10, 14	1
CR5-8	201528-005	**Diode**, MUR810, 8A, PIV 100	-10, 14	4
CR9	201749-012	**Diode**, Bipolar, SA176, 17V	-10, 14	1
CR10-16		**(Same as CR1)**	-10, 14	
CR18-20		**(Same as CR1)**	-10, 14	
CR23	201128-000	**Diode**, Fast Recovery, 3XF1, 300ns, PIV 100	-10, 14	1
CR28-30		**(Same as CR1)**	-10, 14	
CR36,37		**(Same as CR1)**	-10, 14	
CR45-51		**(Same as CR1)**	-10, 14	1
F1	200256-108	**Fuse**, Slow Blow, 15A	-10, 14	1
J20	805706-00	**Flex Assembly, ECG**	-10, 14	1
K1	202045-001	**Relay,** MR604-24-SR	-10, 14	1
Q2, 22	202155-000	**Transistor**, P-Channel, Hex, DIP, IRFD9010, 1W, 4 Contact	-10, 14	2
Q3, 26, 27	202168-000	**Transistor**, N-Channel, Power FET, IRFZ34, TO-220 ⚠	-10, 14	3
Q4, 15, 18, 21	200888-001	**Transistor**, PNP, PN2907A, TO-92	-10, 14	4
Q5, 9, 14, 16, 19	200942-001	**Transistor**, NPN, PN2222A, TO-92	-10, 14	5
Q6-8, 10, 11, 13, 17, 20, 23, 24	200585-001	**Transistor**, FET, VN0106N3, TO-92 ⚠	-10, 14	10
Q12	201738-001	**Transistor**, Power FET, VP0106N3, TO-92 ⚠	-10, 14	1
Q25A, 25B	201696-000	**Transistor**, NPN, Power MOSFET, IRF540, TO-220AB	-10, 14	2
R114, R207	202071-001	**Resistor**, 50M-Ω, 1W, 5%, MG730	-10, 14	2
RN7	200423-074	**Resistor Network**, 8 x 50kΩ, 1.75W, 2%, 16 Contact	-10, 14	1

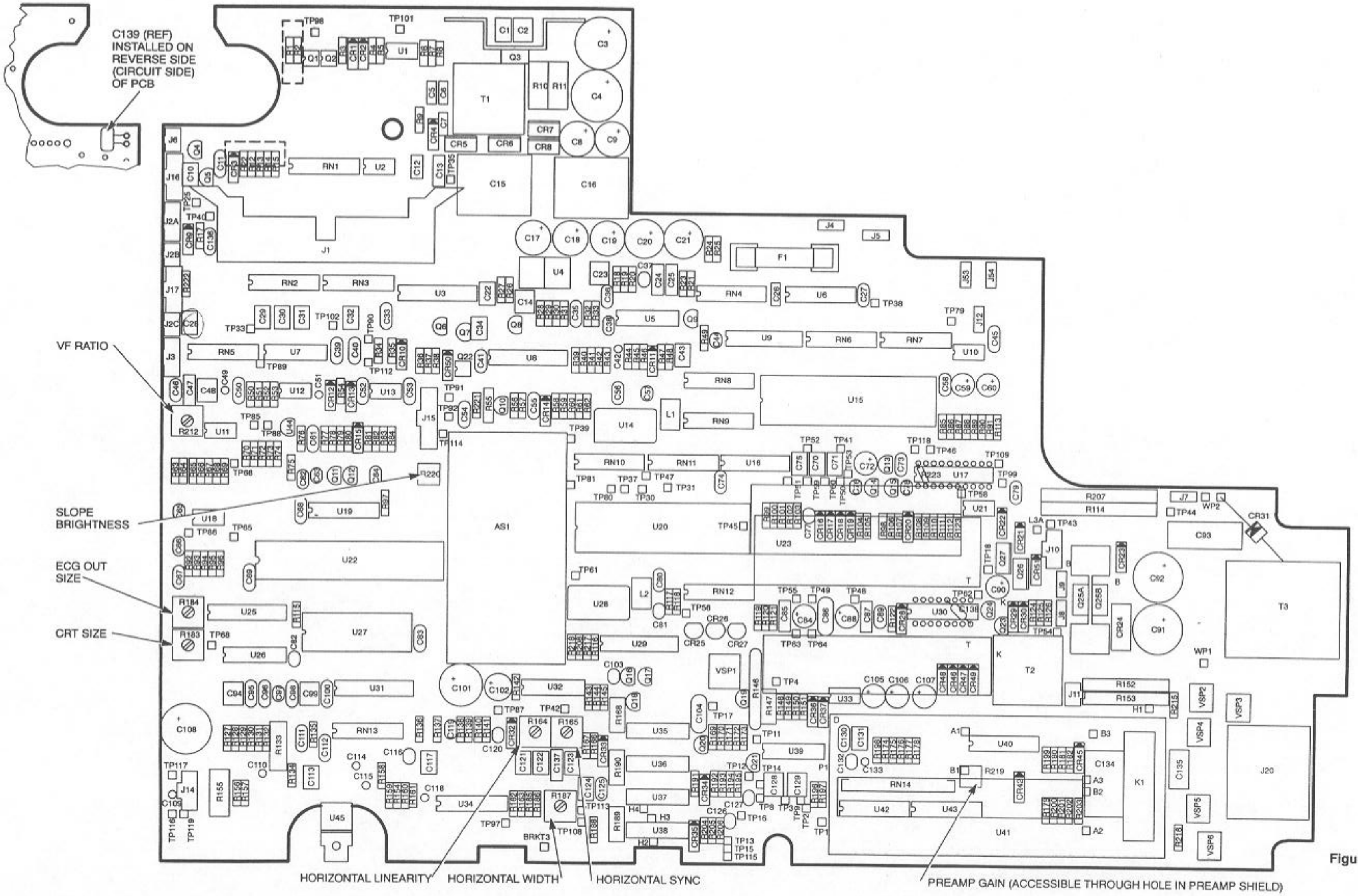
5-3 Ref	Part Number	Description	Used On	Qty
RN8, 9, 11, 12	200424-051	**Resistor Network**, 15 x 100kΩ, 0.10W, 2%, 16 Contact	-10, 14	4
U1	202050-000	**IC**, Linear, PWM3843N	-10, 14	1
U2	202167-000	**IC**, Interface, A/D Converter, ADC0831 ⚠	-10, 14	1
U3, 7, 8, 17, 31	201511-000	**IC**, Digital, 74HC244, Buffer ⚠	-10, 14	4
U4	202120-001	**IC**, Linear, LM2940, Regulator, 5V	-10, 14	1
U5	200485-002	**IC**, Linear, LM324N, Op Amp, Quad	-10, 14	1
U6	202043-000	**IC**, Interface, 509A, Analog Multiplexer, 4 Channel ⚠	-10, 14	1
U9	202078-003	**IC**, Digital, TLC1541, 10-Bit Converter ⚠	-10, 14	1
U10	202079-000	**IC**, Digital, NMC9306NE, EEROM ⚠	-10, 14	1
U11	202072-000	**IC**, Linear, Voltage/Frequency Converter, LM331M	-10, 14	1
U12	200487-000	**IC**, Linear, LF353, Op Amp, Dual, 18V ⚠	-10, 14	1
U14, 28	202020-020	**Oscillator,** High Speed, Hybrid Clock, 8MHz ⚠	-10, 14	2
U15	804230-503	**IC**, Digital, HD637B01Y0P, System Microcomputer ⚠	-10, 14	1
U16	201387-000	**IC**, Linear, ULN2003, Transistor Array	-10, 14	1
U18, 21	201486-000	**IC**, Linear, LF442, Op Amp, Dual, JFET	-10, 14	2
U19	201611-000	**IC**, Digital, 74HC221, Dual, One-Shot ⚠	-10, 14	1
U20	804230-605	**IC**, Digital, HD637B01YOC, Defib/ECG CMOS	-10, 14	1
U25	201654-000	**IC**, Digital, 7528, Dual Buffer D/A ⚠	-10, 14	1
U26	201214-002	**IC**, Linear, LF444ACN, Quad, Op Amp ⚠	-10, 14	1
U27	201732-000	**IC**, Digital, 6264LP15, RAM, 8 x 8k ⚠	-10, 14	1
U29	202080-000	**IC**, Digital, 74HC240N, Inverting ⚠	-10, 14	1
U30	201126-000	**IC**, Linear, 3525A, PWM Modulator	-10, 14	1
U32, 39	201699-000	**IC**, Digital, 74C914, CMOS Trigger ⚠	-10, 14	2
U34	202139-000	**IC**, TDA1170D, CRT Deflection	-10, 14	1
U35-38	201597-002	**Opto-isolator**, CNY65B, 4-Lead	-10, 14	4
U40, 43	201743-001	**IC**, Interface, 509, Analog Multiplexer, 4 Channel ⚠	-10, 14	2
U42	201658-000	**IC**, Interface, DG211CJ, Analog Switch, SPST ⚠	-10, 14	1
U44	200933-000	**IC**, Linear, Voltage Reference Diode, LM336BZ, 2.5V, TO-92	-10, 14	1
U45	202119-002	**IC**, Linear, LM675, Op Amp	-10, 14	1
VSP2,4	200324-011	**Voltage Surge Protector,** 470V/1pF	-10, 14	2
VSP3,5,6	200324-010	**Voltage Surge Protector,** 270V/1pF	-10, 14	3

5-3 Ref	Part Number	Description	Used On	Qty
2	201765-097	**Adhesive**, Foam, Poron, .25W x .062 Thk	-10, 14	1
3	201765-097	**Adhesive**, Tape, Foam, Double-stick, .75W x .045Thk	-14	1
4	804235-01	**Heat Sink**, Vertical Deflection	-10, 14	1
5	202196-000	**Insulator**, Transistor, TO-222, White #2015-54	-10, 14	1
6	805899-01	**PFC - Shield**, Anode Supply	-10, 14	1
7	202253-536	**Screw**, Machine, PH, Nylok, P, SS, #4-40 x .250L	-10, 14	3
8	200476-536	**Screw**, Machine, PH, P, SS, #4-40 x .250L	-10, 14	1
9	804243-05	**Shield**, Preamp, Lower, Painted	-10, 14	1
10	200431-849	**Washer**, Shoulder, Insul, #4, .115ID x .200OD	-10, 14	1



A1

Figure 5-3 PCB Assembly with Heatsink
Part Number 806369-10, -14

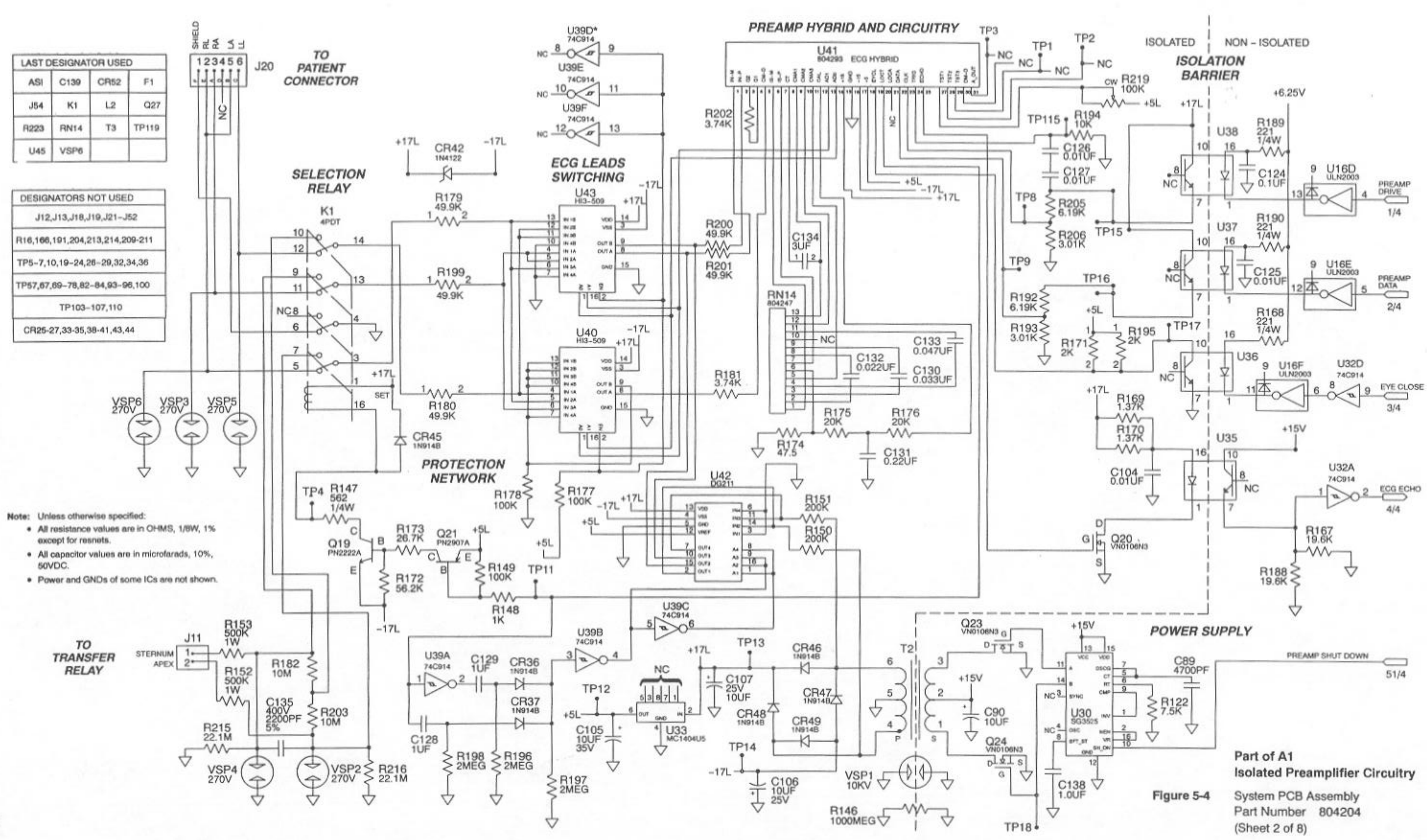

C139 (REF) INSTALLED ON REVERSE SIDE (CIRCUIT SIDE) OF PCB
VF RATIO
SLOPE BRIGHTNESS
ECG OUT SIZE
CRT SIZE
HORIZONTAL LINEARITY
HORIZONTAL WIDTH
HORIZONTAL SYNC
PREAMP GAIN (ACCESSIBLE THROUGH HOLE IN PREAMP SHIELD)
AS1
T1
T2
T3
J1
J20
K1
U15
U20
U22
U23
U27
U41

Part of A1

Figure 5-4 System PCB Assembly
Part Number 804204
(Sheet 1 of 8)

LAST DESIGNATOR USED			
ASI	C139	CR52	F1
J54	K1	L2	Q27
R223	RN14	T3	TP119
U45	VSP6		

DESIGNATORS NOT USED
J12,J13,J18,J19,J21–J52
R16,166,191,204,213,214,209-211
TP5–7,10,19–24,26–29,32,34,36
TP57,67,69–78,82–84,93–96,100
TP103–107,110
CR25-27,33-35,38-41,43,44


TO PATIENT CONNECTOR
J20
SHIELD RL RA LA LL
1 2 3 4 5 6
NC
SELECTION RELAY
K1 4PDT
ECG LEADS SWITCHING
U43 HI3-509
U40 HI3-509
U39D* 74C914
U39E 74C914
U39F 74C914
CR42 1N4122
R179 49.9K
R199 49.9K
R180 49.9K
CR45 1N914B
PROTECTION NETWORK
TP4 R147 562 1/4W
Q19 PN2222A
R173 26.7K
Q21 PN2907A
R172 56.2K
R149 100K
R148 1K
TP11
R178 100K
R177 100K
VSP6 270V
VSP3 270V
VSP5 270V
TO TRANSFER RELAY
J11 STERNUM APEX
R153 500K 1W
R152 500K 1W
R182 10M
R203 10M
C135 400V 2200PF 5%
R215 22.1M
R216 22.1M
VSP4 270V
VSP2 270V
U39A 74C914
C129 1UF
C128 1UF
CR36 1N914B
CR37 1N914B
R198 2MEG
R196 2MEG
R197 2MEG
U39B 74C914
U39C 74C914
TP12
C105 10UF 35V
U33 MC1404U5
TP13
C107 25V 10UF
TP14
C106 10UF 25V
CR46 1N914B
CR47 1N914B
CR48 1N914B
CR49 1N914B
U42 DG211
R151 200K
R150 200K
PREAMP HYBRID AND CIRCUITRY
U41 804293 ECG HYBRID
R202 3.74K
R200 49.9K
R201 49.9K
R181 3.74K
C134 3UF
RN14 804247
C133 0.047UF
C132 0.022UF
C130 0.033UF
R175 20K
R176 20K
R174 47.5
C131 0.22UF
TP3 TP1 TP2
R219 100K
TP115 R194 10K
C126 0.01UF
C127 0.01UF
TP8
R205 6.19K
R206 3.01K
TP15
TP9
TP16
R192 6.19K
R193 3.01K
R171 2K
R195 2K
TP17
R169 1.37K
R170 1.37K
C104 0.01UF
Q20 VN0106N3
ISOLATED
NON - ISOLATED
ISOLATION BARRIER
+6.25V
U38 U37 U36 U35
R189 221 1/4W
C124 0.1UF
R190 221 1/4W
C125 0.01UF
R168 221 1/4W
U16D ULN2003
U16E ULN2003
U16F ULN2003
U32D 74C914
U32A 74C914
PREAMP DRIVE 1/4
PREAMP DATA 2/4
EYE CLOSE 3/4
ECG ECHO 4/4
R167 19.6K
R188 19.6K
POWER SUPPLY
T2
VSP1 10KV
R146 1000MEG
Q23 VN0106N3
Q24 VN0106N3
C90 10UF
U30 SG3525
C89 4700PF
R122 7.5K
C138 1.0UF
TP18
PREAMP SHUT DOWN 51/4

Note: Unless otherwise specified:
- All resistance values are in OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

Figure 5-4

Part of A1
Isolated Preamplifier Circuitry

System PCB Assembly
Part Number 804204
(Sheet 2 of 8)

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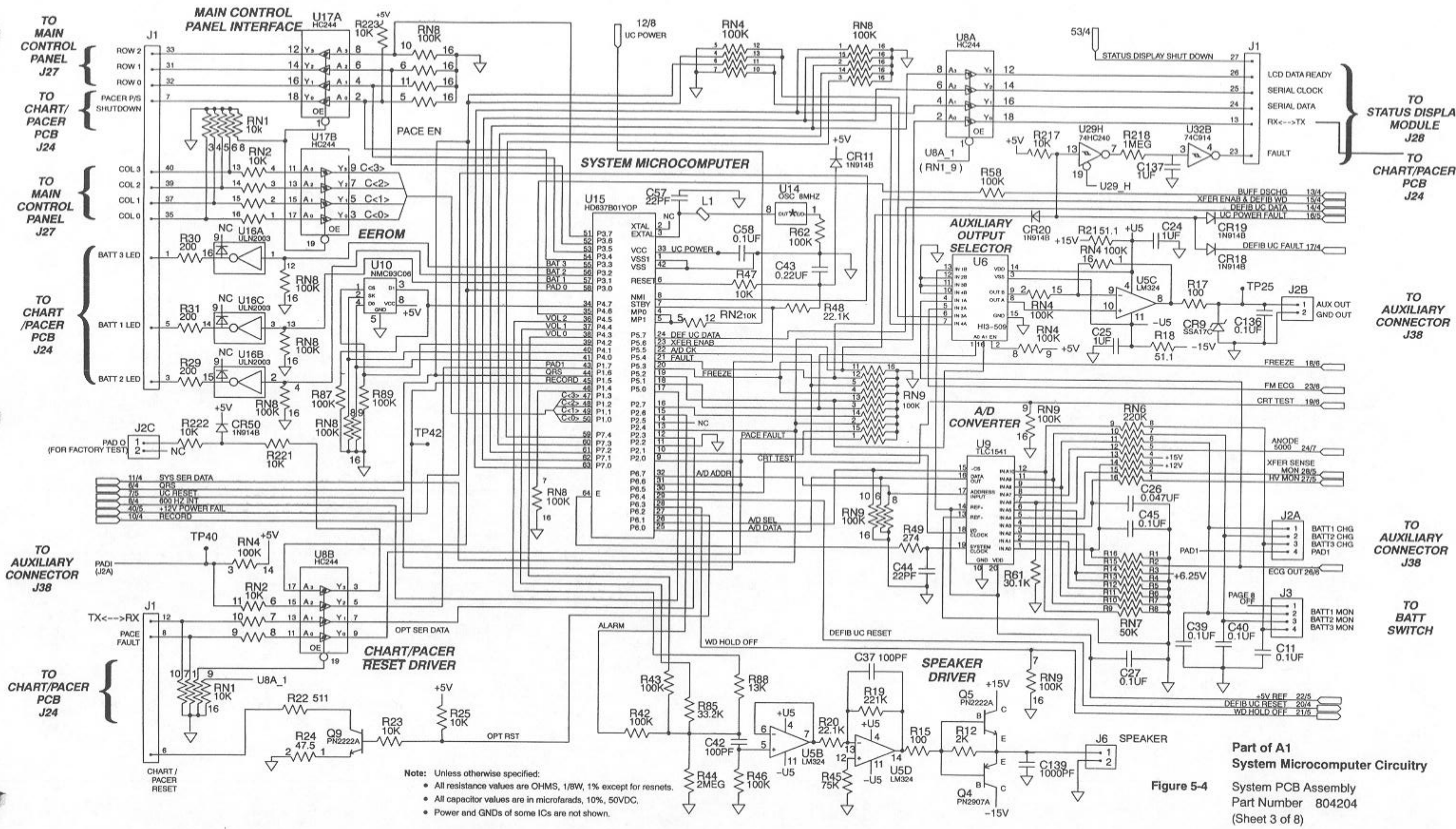
TO MAIN CONTROL PANEL J27
ROW 2
ROW 1
ROW 0
TO CHART/PACER PCB J24
PACER P/S SHUTDOWN
TO MAIN CONTROL PANEL J27
COL 3
COL 2
COL 1
COL 0
TO CHART /PACER PCB J24
BATT 3 LED
BATT 1 LED
BATT 2 LED
J1
MAIN CONTROL PANEL INTERFACE
U17A HC244
U17B HC244
R223 10K
RN8 100K
PACE EN
RN1 10k
RN2 10K
C<3>
C<2>
C<1>
C<0>
EEROM
U10 NMC93C06
U16A ULN2003
U16C ULN2003
U16B ULN2003
R30 200
R31 200
R29 200
R87 100K
R89 100K
J2C
PAD 0
(FOR FACTORY TEST)
R222 10K
CR50 1N914B
R221 10K
TP42
SYS SER DATA
QRS
UC RESET
600 HZ INT
+12V POWER FAIL
RECORD
TO AUXILIARY CONNECTOR J38
PADI (J2A)
TP40
RN4 100K
U8B HC244
OPT SER DATA
TX<-->RX
PACE FAULT
TO CHART/PACER PCB J24
CHART / PACER RESET
CHART/PACER RESET DRIVER
U8A_1
R22 511
R24 47.5
Q9 PN2222A
R23 10K
R25 10K
OPT RST
12/8 UC POWER
SYSTEM MICROCOMPUTER
U15 HD637B01YOP
C57 22PF
L1
U14 OSC 8MHZ
C58 0.1UF
R62 100K
C43 0.22UF
R47 10K
RN2 10K
R48 22.1K
BAT 3
BAT 2
BAT 1
PAD 0
VOL 2
VOL 1
VOL 0
PAD1
QRS
RECORD
UC POWER
DEF UC DATA
XFER ENAB
A/D CK
FAULT
FREEZE
PACE FAULT
CRT TEST
A/D ADDR
A/D SEL
A/D DATA
ALARM
WD HOLD OFF
DEFIB UC RESET
RN4 100K
RN8 100K
U8A HC244
(RN1_9)
+5V
CR11 1N914B
R58 100K
53/4
STATUS DISPLAY SHUT DOWN
U29H 74HC240
R217 10K
R218 1MEG
C137 1UF
U32B 74C914
U29_H
J1
LCD DATA READY
SERIAL CLOCK
SERIAL DATA
RX<-->TX
FAULT
TO STATUS DISPLA MODULE J28
TO CHART/PACER PCB J24
BUFF DSCHG 13/4
XFER ENAB & DEFIB WD 15/4
DEFIB UC DATA 14/4
UC POWER FAULT 16/5
CR19 1N914B
DEFIB UC FAULT 17/4
CR18 1N914B
CR20 1N914B
AUXILIARY OUTPUT SELECTOR
U6 HI3-509
R215 1.1
C24 1UF
RN4 100K
U5C LM324
R17 100
TP25
J2B
AUX OUT
GND OUT
TO AUXILIARY CONNECTOR J38
C25 1UF
R18 51.1
CR9 SSA17C
C136 0.1UF
FREEZE 18/6
FM ECG 23/8
CRT TEST 19/8
RN9 100K
A/D CONVERTER
U9 TLC1541
RN6 220K
ANODE 5000 24/7
XFER SENSE MON 28/5
HV MON 27/5
C26 0.047UF
C45 0.1UF
R49 274
C44 22PF
R61 30.1K
RN7 50K
+6.25V
J2A
BATT1 CHG
BATT2 CHG
BATT3 CHG
PAD1
ECG OUT 26/8
TO AUXILIARY CONNECTOR J38
J3
PAGE 8 OFF
BATT1 MON
BATT2 MON
BATT3 MON
TO BATT SWITCH
C39 0.1UF
C40 0.1UF
C11 0.1UF
C27 0.1UF
+5V REF 22/5
DEFIB UC RESET 20/4
WD HOLD OFF 21/5
R43 100K
R42 100K
R85 33.2K
R44 2MEG
R88 13K
C42 100PF
R46 100K
U5B LM324
C37 100PF
R19 221K
R20 22.1K
R45 75K
U5D LM324
R15 100
SPEAKER DRIVER
Q5 PN2222A
R12 2K
Q4 PN2907A
+15V
-15V
C139 1000PF
J6 SPEAKER

Note: Unless otherwise specified:
- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

Figure 5-4

Part of A1
System Microcomputer Circuitry

System PCB Assembly
Part Number 804204
(Sheet 3 of 8)

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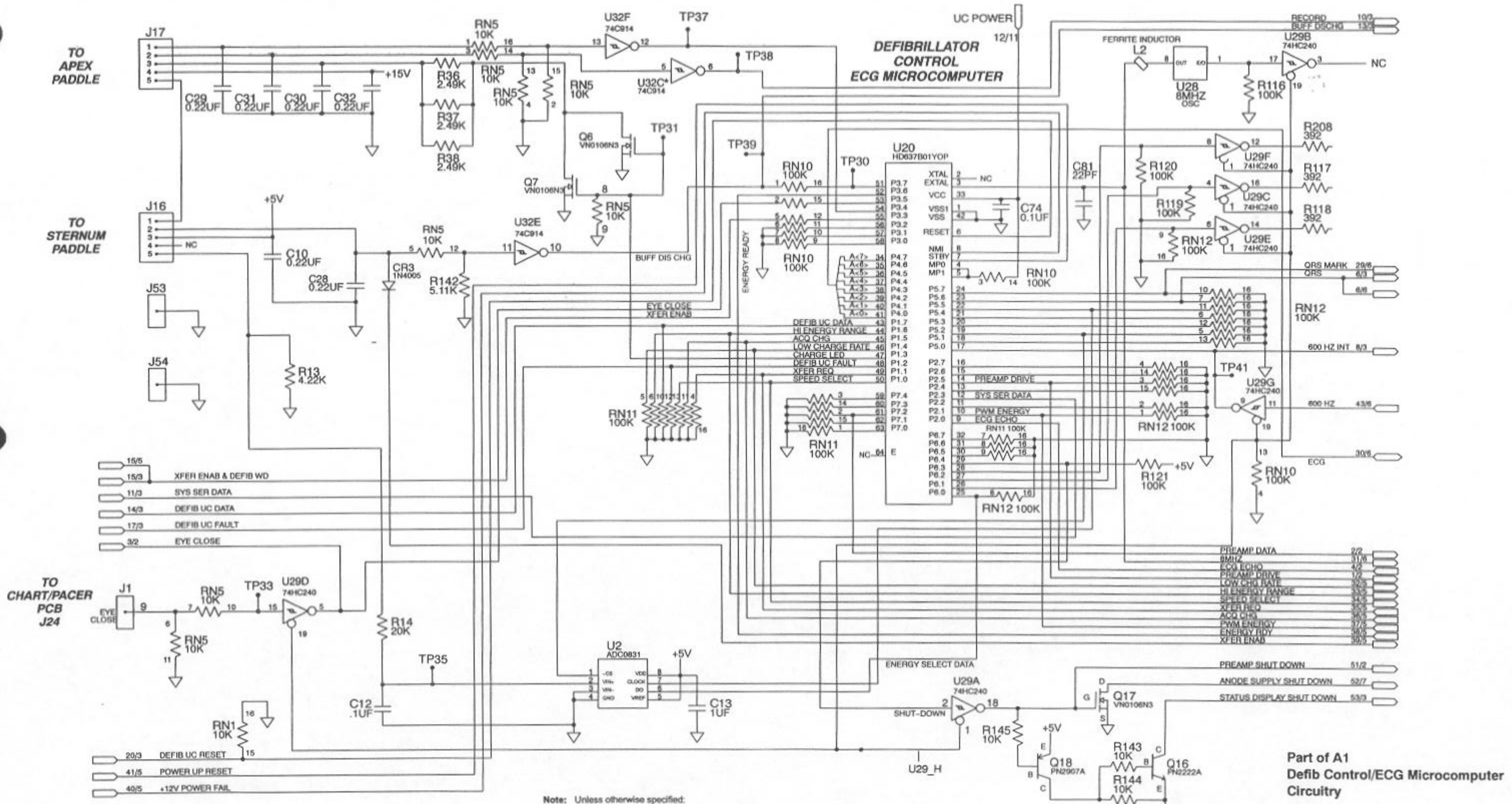

DEFIBRILLATOR
CONTROL
ECG MICROCOMPUTER
TO APEX PADDLE
TO STERNUM PADDLE
TO CHART/PACER PCB J24
J17
J16
J53
J54
J1
EYE CLOSE
UC POWER
12/11
U20
HD637B01YOP
U2
ADC0831
U28
8MHZ
OSC
FERRITE INDUCTOR
L2
U29B 74HC240
U29F 74HC240
U29C 74HC240
U29E 74HC240
U29G 74HC240
U29A 74HC240
U29D 74HC240
U32F 74C914
U32C 74C914
U32E 74C914
Q6 VN0106N3
Q7 VN0106N3
Q17 VN0106N3
Q18 PN2907A
Q16 PN2222A
CR3 1N4005
C29 0.22UF
C31 0.22UF
C30 0.22UF
C32 0.22UF
C10 0.22UF
C28 0.22UF
C81 22PF
C74 0.1UF
C12 .1UF
C13 1UF
R36 2.49K
R37 2.49K
R38 2.49K
R13 4.22K
R142 5.11K
R14 20K
R116 100K
R120 100K
R119 100K
R121 100K
R208 392
R117 392
R118 392
R145 10K
R143 10K
R144 10K
RN5 10K
RN10 100K
RN11 100K
RN12 100K
RN1 10K
TP30
TP31
TP33
TP35
TP37
TP38
TP39
TP41
+15V
+5V
-15V
NC
BUFF DIS CHG
ENERGY READY
EYE CLOSE
XFER ENAB
DEFIB UC DATA
HI ENERGY RANGE
ACQ CHG
LOW CHARGE RATE
CHARGE LED
DEFIB UC FAULT
XFER REQ
SPEED SELECT
PREAMP DRIVE
SYS SER DATA
PWM ENERGY
ECG ECHO
ENERGY SELECT DATA
SHUT-DOWN
U29_H
RECORD 10/3
BUFF DSCHG 13/3
QRS MARK 29/6
QRS 6/3
6/6
600 HZ INT 8/3
600 HZ 43/6
ECG 30/6
PREAMP DATA 2/2
8MHZ 31/6
ECG ECHO 4/2
PREAMP DRIVE
LOW CHG RATE
HI ENERGY RANGE
SPEED SELECT
XFER REQ
ACQ CHG
PWM ENERGY
ENERGY RDY
XFER ENAB
PREAMP SHUT DOWN 51/2
ANODE SUPPLY SHUT DOWN 52/7
STATUS DISPLAY SHUT DOWN 53/3
15/5
15/3 XFER ENAB & DEFIB WD
11/3 SYS SER DATA
14/3 DEFIB UC DATA
17/3 DEFIB UC FAULT
3/2 EYE CLOSE
20/3 DEFIB UC RESET
41/5 POWER UP RESET
40/5 +12V POWER FAIL

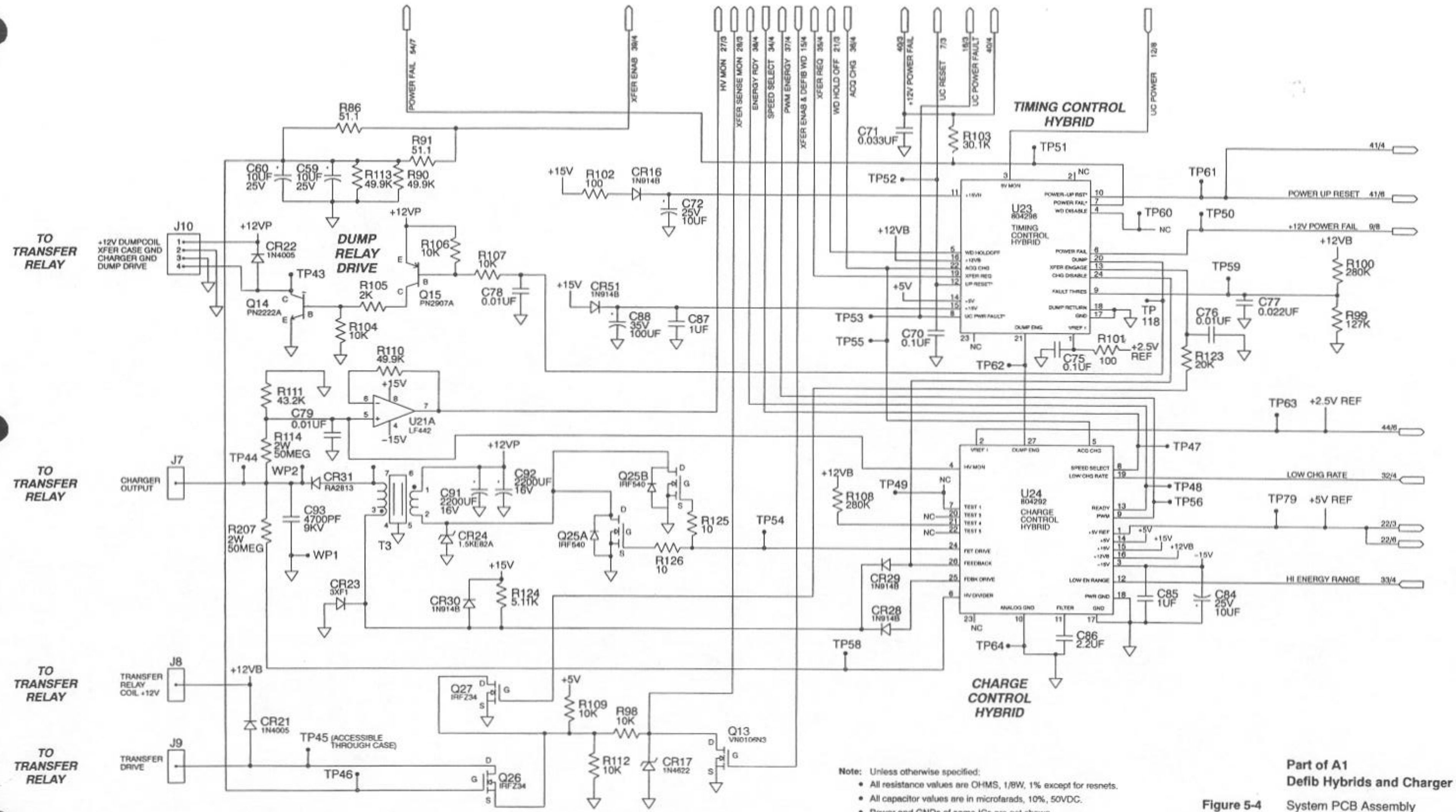
Note: Unless otherwise specified:

- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

Figure 5-4

Part of A1
Defib Control/ECG Microcomputer Circuitry

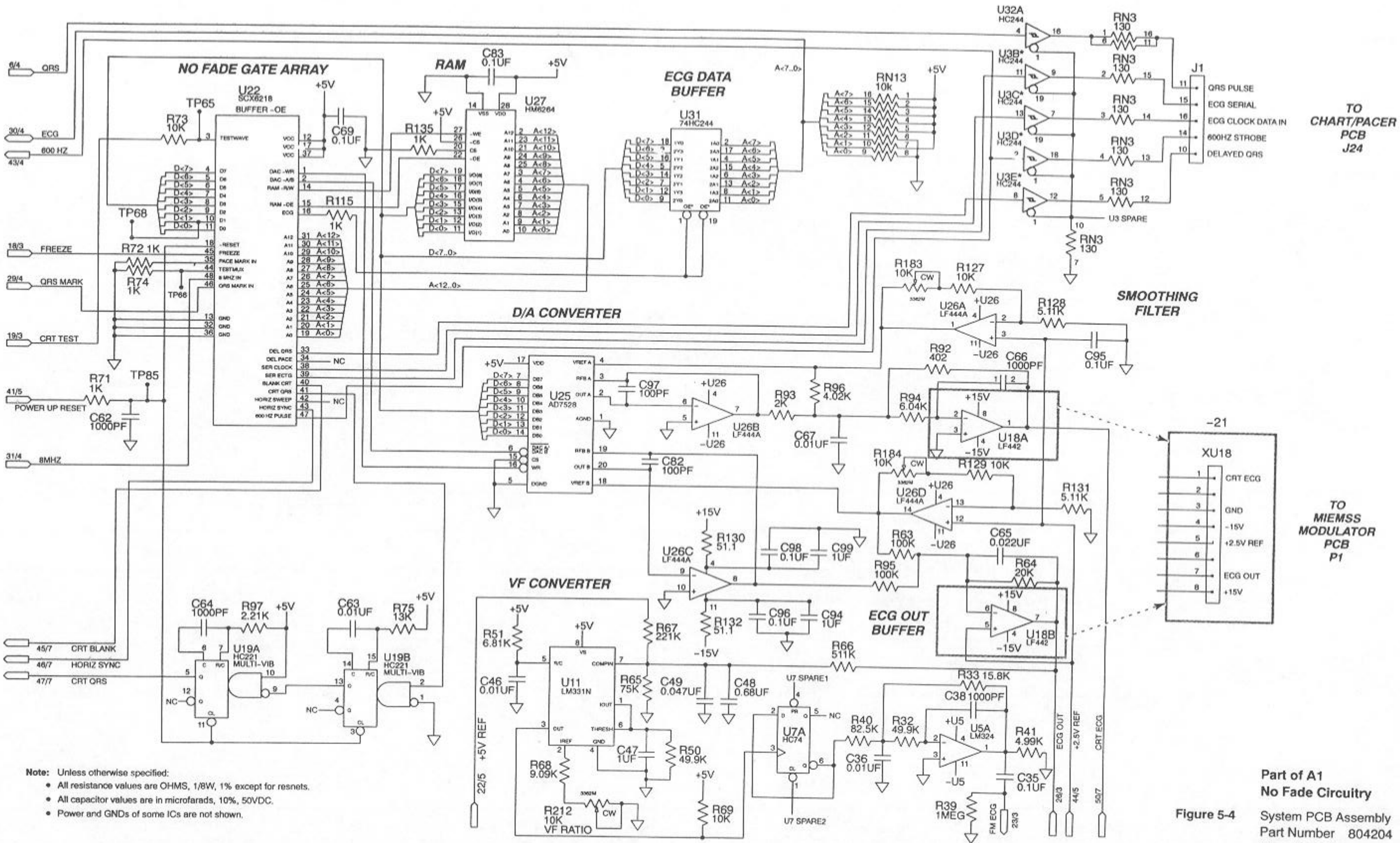
System PCB Assembly
Part Number 804204
(Sheet 4 of 8)


TO TRANSFER RELAY
TO TRANSFER RELAY
TO TRANSFER RELAY
TO TRANSFER RELAY
J10
+12V DUMPCOIL
XFER CASE GND
CHARGER GND
DUMP DRIVE
J7
CHARGER OUTPUT
J8
TRANSFER RELAY COIL +12V
J9
TRANSFER DRIVE
DUMP RELAY DRIVE
TIMING CONTROL HYBRID
CHARGE CONTROL HYBRID
U23
804298
TIMING CONTROL HYBRID
U24
804292
CHARGE CONTROL HYBRID
U21A
LF442
POWER FAIL 54/7
XFER ENAB 39/4
HV MON 27/3
XFER SENSE MON 28/3
ENERGY RDY 38/4
SPEED SELECT 34/4
PWM ENERGY 37/4
XFER ENAB & DEFIB WD 15/4
XFER REQ 35/4
WD HOLD OFF 21/3
ACQ CHG 36/4
+12V POWER FAIL 40/3
UC RESET 7/3
UC POWER FAULT 18/3
40/4
UC POWER 12/8
POWER UP RESET 41/8
41/4
+12V POWER FAIL 9/8
44/6
LOW CHG RATE 32/4
22/3
22/8
HI ENERGY RANGE 33/4
+2.5V REF
+5V REF
R86 51.1
R91 51.1
C60 10UF 25V
C59 10UF 25V
R113 49.9K
R90 49.9K
CR22 1N4005
TP43
Q14 PN2222A
R105 2K
R104 10K
Q15 PN2907A
R106 10K
R107 10K
C78 0.01UF
R102 100
CR16 1N914B
C72 25V 10UF
CR51 1N914B
C88 35V 100UF
C87 1UF
R110 49.9K
R111 43.2K
C79 0.01UF
R114 2W 50MEG
TP44
WP2
CR31 RA2813
C93 4700PF 9KV
WP1
R207 2W 50MEG
T3
C91 2200UF 16V
C92 2200UF 16V
CR24 1.5KE82A
CR23 3XF1
CR30 1N914B
R124 5.11K
Q25B IRF540
Q25A IRF540
R125 10
R126 10
TP54
Q27 IRFZ34
R109 10K
R98 10K
R112 10K
CR17 1N4622
Q13 VN0106N3
CR21 1N4005
TP45 (ACCESSIBLE THROUGH CASE)
TP46
Q26 IRFZ34
C71 0.033UF
R103 30.1K
TP51
TP52
TP53
TP55
C70 0.1UF
TP62
C75 0.1UF
R101 100
TP 118
TP60
TP61
TP50
TP59
C76 0.01UF
C77 0.022UF
R100 280K
R99 127K
R123 20K
TP63
TP47
TP48
TP56
TP79
TP49
R108 280K
CR29 1N914B
CR28 1N914B
TP58
TP64
C86 2.2UF
C85 1UF
C84 25V 10UF
+12VP
+12VB
+15V
-15V
+5V
NC

Note: Unless otherwise specified:
- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

Figure 5-4 Part of A1
Defib Hybrids and Charger Circuitry

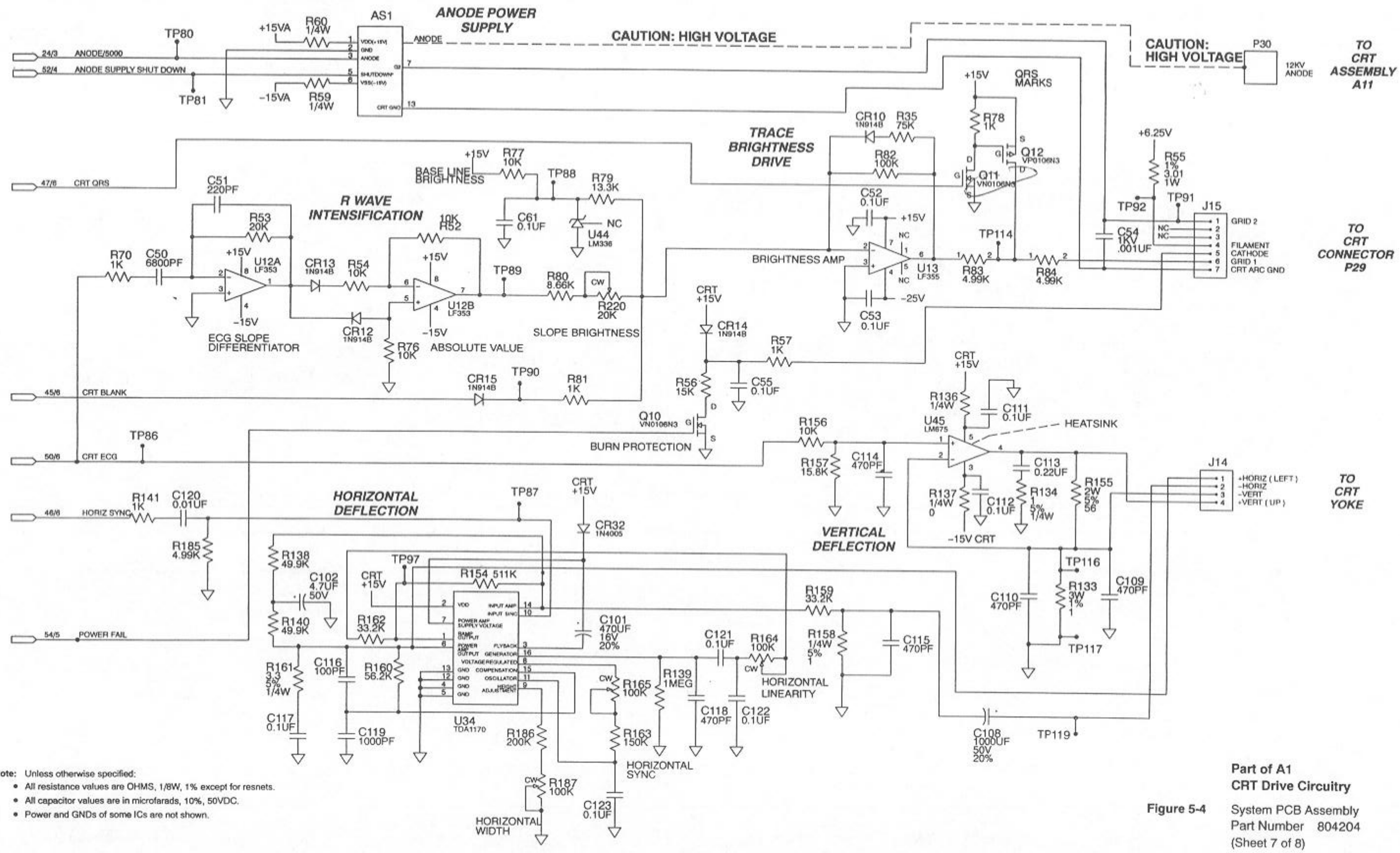
System PCB Assembly
Part Number 804204
(Sheet 5 of 8)


NO FADE GATE ARRAY
U22
SCX6218
BUFFER -OE
RAM
U27
HM6264
C83
0.1UF
ECG DATA BUFFER
U31
74HC244
RN13
10k
D/A CONVERTER
U25
AD7528
SMOOTHING FILTER
VF CONVERTER
U11
LM331N
ECG OUT BUFFER
U18A
LF442
U18B
LF442
U26A
LF444A
U26B
LF444A
U26C
LF444A
U26D
LF444A
U19A
HC221
MULTI-VIB
U19B
HC221
MULTI-VIB
U7A
HC74
U5A
LM324
U32A
HC244
U3B*
U3C*
U3D*
U3E*
RN3
130
U3 SPARE
J1
QRS PULSE
ECG SERIAL
ECG CLOCK DATA IN
600HZ STROBE
DELAYED QRS
TO CHART/PACER PCB J24
-21
XU18
CRT ECG
GND
-15V
+2.5V REF
ECG OUT
+15V
TO MIEMSS MODULATOR PCB P1
6/4 QRS
30/4 ECG
43/4 600 HZ
18/3 FREEZE
29/4 QRS MARK
19/3 CRT TEST
41/5 POWER UP RESET
31/4 8MHZ
45/7 CRT BLANK
46/7 HORIZ SYNC
47/7 CRT QRS
22/5 +5V REF
26/3 ECG OUT
44/5 +2.5V REF
50/7 CRT ECG
23/3 FM ECG
TP65
TP68
TP85
R73 10K
R72 1K
R74 1K
R71 1K
C62 1000PF
C69 0.1UF
R115 1K
R135 1K
D<7..0>
A<12..0>
A<7..0>
NC
R183 10K
R127 10K
R128 5.11K
C95 0.1UF
R92 402
C66 1000PF
C97 100PF
R93 2K
R96 4.02K
R94 6.04K
C67 0.01UF
C82 100PF
R184 10K
R129 10K
R131 5.11K
R63 100K
C65 0.022UF
R64 20K
R95 100K
R130 51.1
R132 51.1
C98 0.1UF
C99 1UF
C96 0.1UF
C94 1UF
R51 6.81K
C46 0.01UF
R67 221K
R65 75K
C49 0.047UF
C48 0.68UF
C47 1UF
R50 49.9K
R68 9.09K
R212 10K VF RATIO
R69 10K
R66 511K
R33 15.8K
C38 1000PF
R40 82.5K
R32 49.9K
C36 0.01UF
R41 4.99K
C35 0.1UF
R39 1MEG
U7 SPARE1
U7 SPARE2
C64 1000PF
R97 2.21K
C63 0.01UF
R75 13K
+5V
+15V
-15V
+U26
-U26
+U5
-U5
CW

Note: Unless otherwise specified:

- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

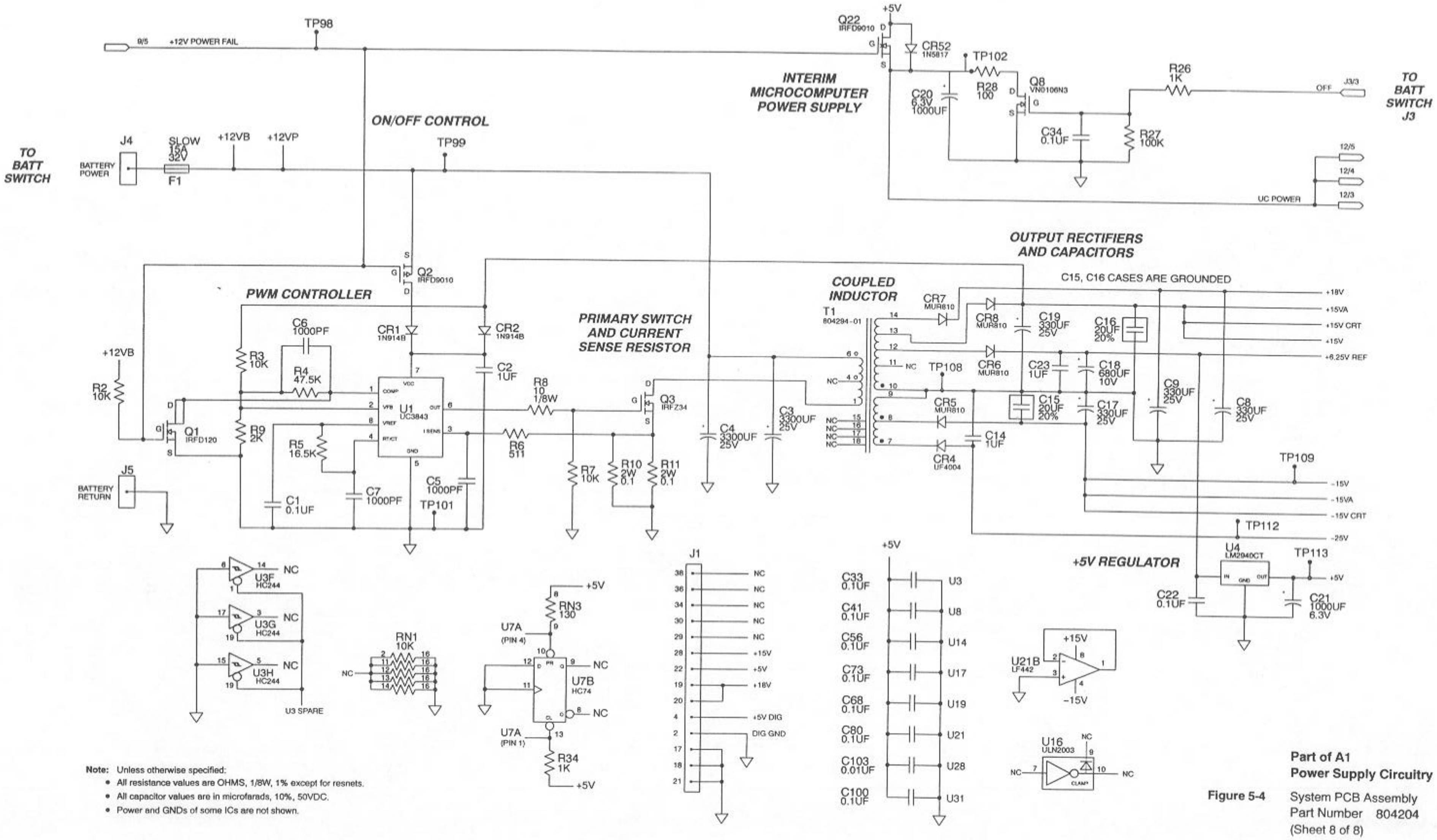
Figure 5-4 **Part of A1**
No Fade Circuitry
System PCB Assembly
Part Number 804204
(Sheet 6 of 8)


ANODE POWER SUPPLY
AS1
TP80
24/3 ANODE/5000
52/4 ANODE SUPPLY SHUT DOWN
TP81
+15VA
R60 1/4W
-15VA
R59 1/4W
VDD(+15V)
GND
ANODE
SHUTDOWN*
VSS(-15V)
CRT GND
ANODE
CAUTION: HIGH VOLTAGE
CAUTION: HIGH VOLTAGE
P30
12KV ANODE
TO CRT ASSEMBLY A11
47/8 CRT QRS
TRACE BRIGHTNESS DRIVE
CR10 1N914B
R35 75K
R82 100K
C52 0.1UF
+15V
NC
BRIGHTNESS AMP
U13 LF355
-25V
C53 0.1UF
+15V
QRS MARKS
R78 1K
Q12 VP0106N3
Q11 VN0106N3
TP114
R83 4.99K
R84 4.99K
+6.25V
R55 1% 3.01 1W
TP92
TP91
C54 1KV .001UF
J15
GRID 2
FILAMENT
CATHODE
GRID 1
CRT ARC GND
TO CRT CONNECTOR P29
R WAVE INTENSIFICATION
C51 220PF
R53 20K
R70 1K
C50 6800PF
U12A LF353
ECG SLOPE DIFFERENTIATOR
CR13 1N914B
R54 10K
CR12 1N914B
10K R52
U12B LF353
R76 10K
ABSOLUTE VALUE
+15V R77 10K
BASE LINE BRIGHTNESS
TP88
C61 0.1UF
R79 13.3K
U44 LM336
TP89
R80 8.66K
CW
R220 20K
SLOPE BRIGHTNESS
45/8 CRT BLANK
CR15 1N914B
TP90
R81 1K
CRT +15V
CR14 1N914B
R57 1K
R56 15K
C55 0.1UF
Q10 VN0106N3
BURN PROTECTION
50/8 CRT ECG
TP86
CRT +15V
R136 1/4W
C111 0.1UF
U45 LM675
HEATSINK
R156 10K
R157 15.8K
C114 470PF
R137 1/4W 0
C112 0.1UF
-15V CRT
C113 0.22UF
R134 1 5% 1/4W
R155 2W 5% 56
J14
+HORIZ (LEFT)
-HORIZ
-VERT
+VERT (UP)
TO CRT YOKE
VERTICAL DEFLECTION
TP116
C110 470PF
R133 3W 1% 1
C109 470PF
TP117
C108 1000UF 50V 20%
TP119
46/8 HORIZ SYNC
R141 1K
C120 0.01UF
R185 4.99K
HORIZONTAL DEFLECTION
TP87
CRT +15V
CR32 1N4005
R138 49.9K
C102 4.7UF 50V
R140 49.9K
TP97
CRT +15V
R154 511K
R162 33.2K
U34 TDA1170
VDD
INPUT AMP
INPUT SYNC
POWER AMP SUPPLY VOLTAGE
RAMP OUTPUT
POWER AMP OUTPUT
FLYBACK GENERATOR
VOLTAGE REGULATED
GND
COMPENSATION
OSCILLATOR
HEIGHT ADJUSTMENT
C101 470UF 16V 20%
54/5 POWER FAIL
R161 3.3 5% 1/4W
C116 100PF
R160 56.2K
C117 0.1UF
C119 1000PF
R186 200K
R187 100K
HORIZONTAL WIDTH
R165 100K
R163 150K
HORIZONTAL SYNC
C123 0.1UF
R139 1MEG
C118 470PF
C121 0.1UF
C122 0.1UF
R164 100K
HORIZONTAL LINEARITY
R159 33.2K
R158 1/4W 5% 1
C115 470PF

Note: Unless otherwise specified:
- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

Part of A1
CRT Drive Circuitry

Figure 5-4 System PCB Assembly
Part Number 804204
(Sheet 7 of 8)


TP98
9/5
+12V POWER FAIL
TO BATT SWITCH
J4
BATTERY POWER
SLOW 15A 32V
F1
+12VB
+12VP
ON/OFF CONTROL
TP99
Q2 IRFD9010
PWM CONTROLLER
+12VB
R2 10K
Q1 IRFD120
J5
BATTERY RETURN
R3 10K
C6 1000PF
R4 47.5K
R9 2K
R5 16.5K
C1 0.1UF
C7 1000PF
CR1 1N914B
U1 UC3843
VCC
COMP
VFB
VREF
RT/CT
OUT
I SENS
GND
C5 1000PF
TP101
CR2 1N914B
C2 1UF
R8 10 1/8W
R6 511
PRIMARY SWITCH AND CURRENT SENSE RESISTOR
Q3 IRFZ34
R7 10K
R10 2W 0.1
R11 2W 0.1
C4 3300UF 25V
C3 3300UF 25V
COUPLED INDUCTOR
T1 804294-01
NC
OUTPUT RECTIFIERS AND CAPACITORS
C15, C16 CASES ARE GROUNDED
CR7 MUR810
CR8 MUR810
CR6 MUR810
CR5 MUR810
CR4 UF4004
TP108
C19 330UF 25V
C16 20UF 20%
C23 1UF
C18 680UF 10V
C15 20UF 20%
C17 330UF 25V
C14 1UF
C9 330UF 25V
C8 330UF 25V
+18V
+15VA
+15V CRT
+15V
+6.25V REF
TP109
-15V
-15VA
-15V CRT
TP112
-25V
INTERIM MICROCOMPUTER POWER SUPPLY
Q22 IRFD9010
+5V
CR52 1N5817
TP102
R28 100
C20 6.3V 1000UF
Q8 VN0106N3
C34 0.1UF
R26 1K
R27 100K
OFF
J3/3
TO BATT SWITCH J3
12/5
12/4
12/3
UC POWER
+5V REGULATOR
U4 LM2940CT
IN
GND
OUT
TP113
+5V
C22 0.1UF
C21 1000UF 6.3V
U3F HC244
U3G HC244
U3H HC244
U3 SPARE
RN1 10K
U7A (PIN 4)
RN3 130
U7B HC74
U7A (PIN 1)
R34 1K
J1
+15V
+5V
+18V
+5V DIG
DIG GND
C33 0.1UF
C41 0.1UF
C56 0.1UF
C73 0.1UF
C68 0.1UF
C80 0.1UF
C103 0.01UF
C100 0.1UF
U3
U8
U14
U17
U19
U21
U28
U31
U21B LF442
-15V
U16 ULN2003
CLAMP

Note: Unless otherwise specified:

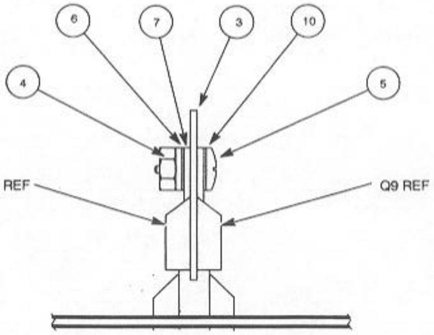
- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

Figure 5-4 **Part of A1**
Power Supply Circuitry
System PCB Assembly
Part Number 804204
(Sheet 8 of 8)

133

5-5 Ref	Part Number	Description	Used On	Qty
A2	804202-22	**Chart PCB Assembly** ⚠	804200-33 thru 37, 39, 41	1
	804202-23	**Chart/Pacer PCB Assembly** ⚠	804200-28 thru 32, 38, 40	1
	804202-20	**Chart/Pacer PCB Assembly**, Military - AFFC ⚠	804200-59, 63	1
	804202-21	**Chart PCB Assembly**, Military ⚠	804200-62	1
		Available Components:		
CR2	202136-003	**Diode**, UF4004	804202-21, 22	2
CR7	202136-006	**Diode**, UF4007	804202-20, 23	1
CR17	201225-004	**Diode**, Schottky, SB160, 1A	-20, 23	1
Q1	202155-000	**Transistor**, FET, IRFD9010, 4 Contact	-20, 21, 22, 23	1
Q2	200585-001	**Transistor**, FET, VN0106N3, TO-92	-20, 21, 22, 23	1
Q4, 6, 12-14	200585-001	**Transistor**, FET, VN0106N3, TO-92	-20, 23	6
Q3	200994-001	**Transistor**, FET, RFP12P08, TO-220AB	-20, 21, 22, 23	1
Q5	201696-000	**Transistor**, MOSFET, IRF540, TO-220	-20, 23	1
Q7	201738-001	**Transistor**, FET VP0106N3, TO-92	-20, 23	1
Q9	201569-000	**Transistor**, FET, IRF830, TO-220	-20, 23	1
Q10, 15	200942-001	**Transistor**, NPN, PN2222A, TO-92	-20, 23	2
Q11	202164-000	**Transistor**, FET, MTD2N50	-20, 23	1
RN4	200422-089	**Resistor Network**, 9 x 10kΩ, 1.25W, 2%, 10 Contact	-20, 21, 22, 23	1
RN5	201240-018	**Resistor Network**, 4 x 100kΩ, 0.33W, 5%, 8 Contact	-20, 23	1
RN6	201240-012	**Resistor Network**, 4 x 10kΩ, 0.33W, 5%, 8 Contact	-20, 23	1
RN9	201240-006	**Resistor Network**, 4 x 1kΩ, 0.33W, 5%, 8 Contact	-20, 23	1
RV100 101	201251-157	**Varistor,** 390V, 92J, 4500A	-20, 23	2
U1	200669-002	**IC**, Linear, LM339, Comparator ⚠	-20, 21, 22, 23	1
U2	200673-007	**IC**, Linear, RCG, 78L12, TO-92 ⚠	-20, 21, 22, 23	2
U3	201387-000	**IC**, ULN2003	-20, 21, 22, 23	1
U4	202020-020	**IC**, Digital, Oscillator ⚠	-20, 21, 22, 23	1
U5	202165-000	**IC**, Digital, 74HC7266 ⚠	-20, 21, 22, 23	1
U6	202074-000	**IC**, Digital, 74HC595 ⚠	-20, 21, 22, 23	1
U8	804230-405	**IC**, Digital, HD637B01Y0P, Microcomputer ⚠	-20, 21, 22, 23	1
U9	201609-000	**IC**, Digital, 74HC138, Decoder ⚠	-20, 21, 22, 23	1
U11	201594-002	**IC**, Digital, ADC0804	-20, 21, 22, 23	1
U12	804280-00	**IC**, Gate Array, Recorder Printhead	-20, 21, 22, 23	1
U13	202050-000	**IC**, Linear, 3843N, Pulse-Width Regulator	-20, 23	1
U14	201705-000	**IC**, Digital, 74HC14, Schmitt Inverter ⚠	-20, 21, 22, 23	1
U19	200673-007	**IC**, Linear, RCG, 78L12, TO-92 (Same as U2) ⚠	-20, 23	1
U20	200445-000	**IC**, Linear, LM392B, Voltage Reference, TO-92	-20, 23	1
U21, 23	200669-002	**IC**, Linear, LM339, Comparator (Same as U1) ⚠	-20, 23	1
U24	200472-000	**IC**, Digital, 4538BC, Dual Multivibrator ⚠	-20, 23	1
U25	200487-000	**IC**, Linear, LF353, Dual Op Amp	-20, 23	1
U28	202160-000	**IC**, Linear, TL431CLP, Voltage Reference	-20, 23	1
U29	202227-000	**IC**, Digital, DS1242, Smartwatch and RAM ⚠	-20, 21, 22, 23	1

5-5 Ref	Part Number	Description (continued from previous page)	Used On	Qty
2	202091-053	**Heatsink**	-20, 21, 22, 23	2
3	202091-052	**Heatsink**, Alum, Blk, Dual TO-220, Vert Mnt	-20, 21, 22, 23	1
4	201199-100	**Nut**, Hex, CS, CP, #4-40 x .188W x .063T	-20, 21, 22, 23	1
5	200476-762	**Screw**, PH, P, CS, CP, #4-40 x .375L	-20, 21, 22, 23	1
6	202413-000	**Washer**, Lock, Split	-20, 21, 22, 23	1
7	200431-849	**Washer**, Nylon Shoulder	-20, 21, 22, 23	2


6
7
3
10
4
5
Q8 REF
Q9 REF

VIEW A

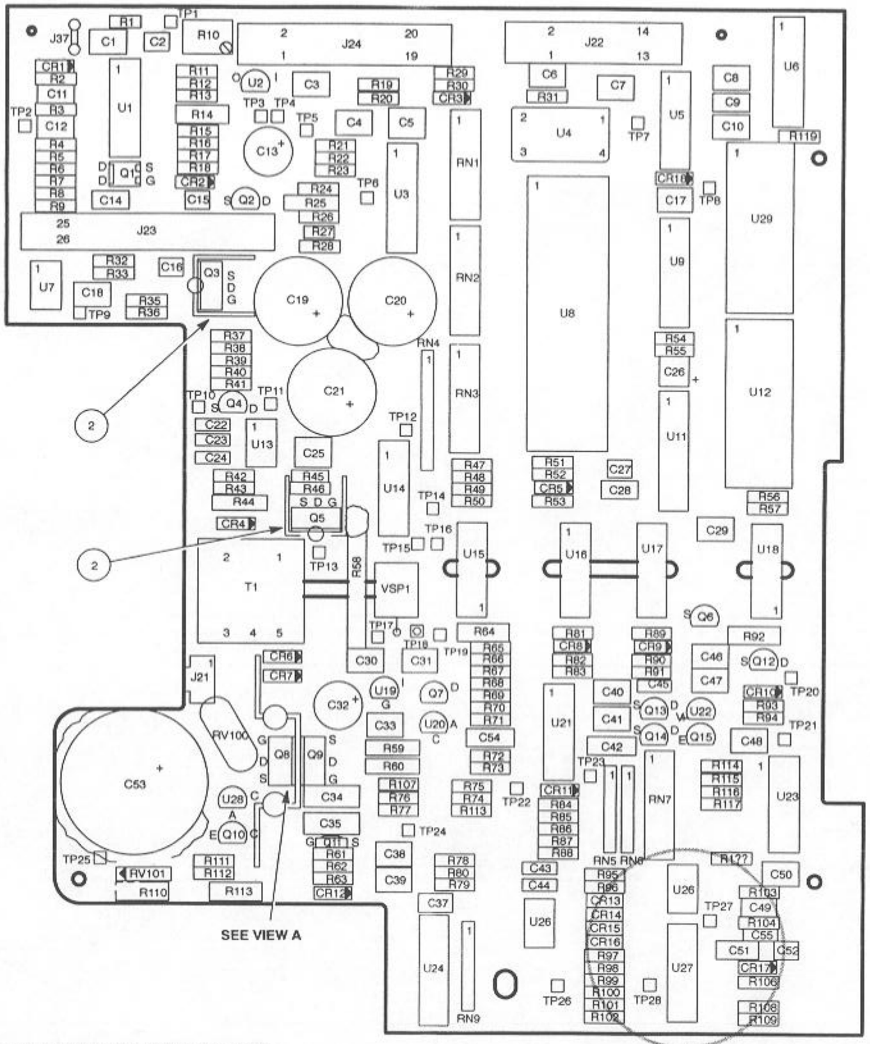
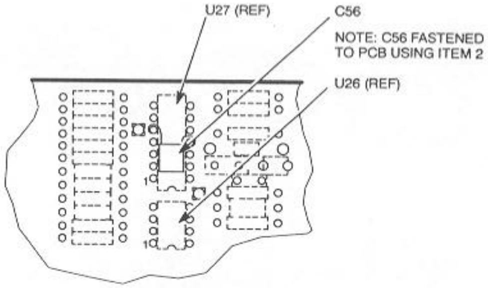
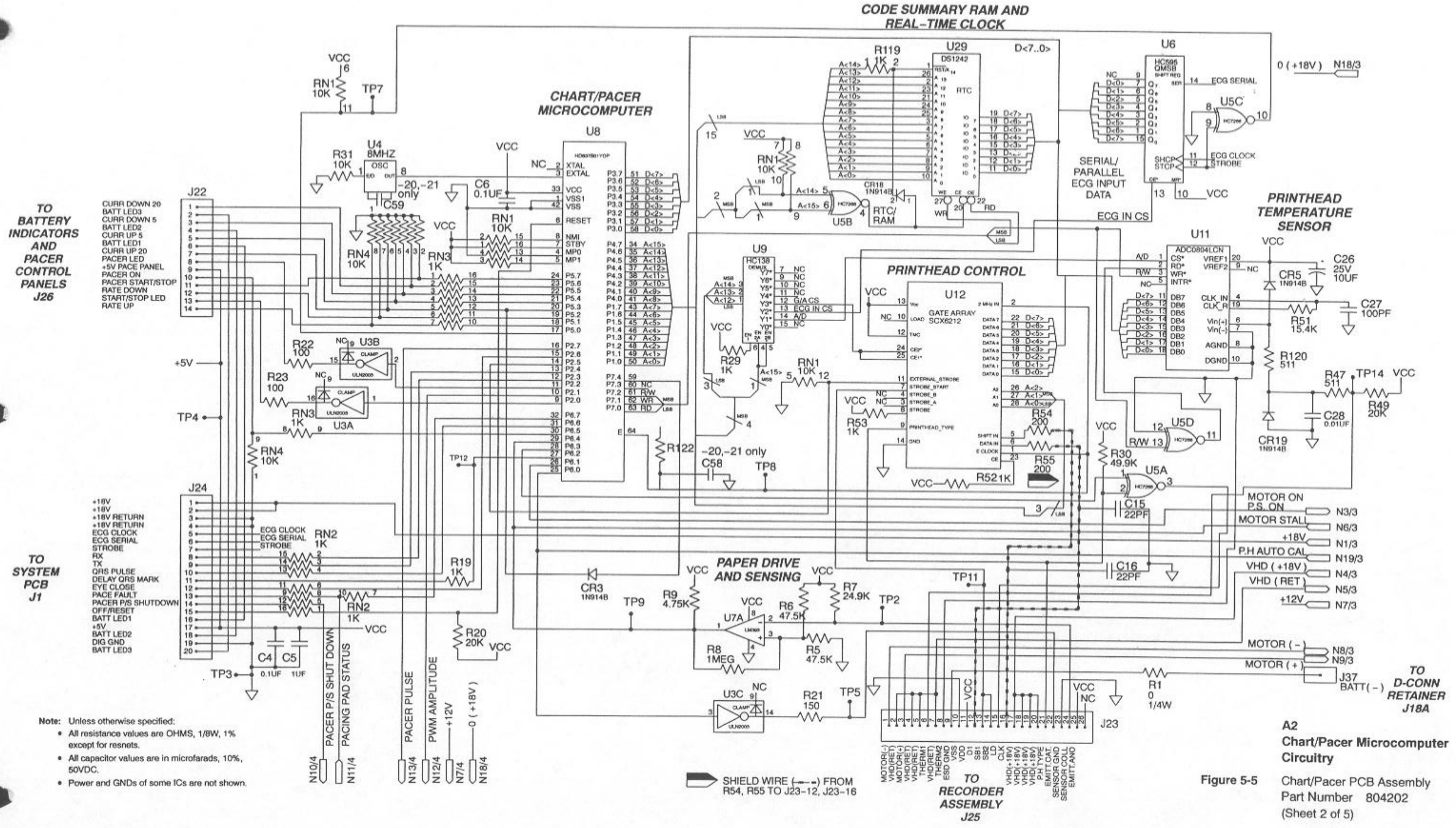

J37
J24
J22
J23
J21
U1
U2
U3
U4
U5
U6
U7
U8
U9
U11
U12
U13
U14
U15
U16
U17
U18
U19
U20
U21
U22
U23
U24
U26
U27
U28
U29
RN1
RN2
RN3
RN4
RN5
RN6
RN7
RN9
VSP1
T1
C19
C20
C21
C32
C53
RV100
RV101
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
2
2
SEE VIEW A
SEE VIEW B

Figure 5-4: A2, Chart/Pacer PCB Assembly


U27 (REF)
C56
NOTE: C56 FASTENED TO PCB USING ITEM 2
U26 (REF)

VIEW B
(CIRCUIT SIDE)

Figure 5-5 A2
Chart/Pacer PCB Assembly
Part Number 804202
(Sheet 1 of 5)


CODE SUMMARY RAM AND REAL-TIME CLOCK
CHART/PACER MICROCOMPUTER
PRINTHEAD CONTROL
PRINTHEAD TEMPERATURE SENSOR
PAPER DRIVE AND SENSING
TO BATTERY INDICATORS AND PACER CONTROL PANELS J26
TO SYSTEM PCB J1
TO RECORDER ASSEMBLY J25
TO D-CONN RETAINER J18A
J22
CURR DOWN 20
BATT LED3
CURR DOWN 5
BATT LED2
CURR UP 5
BATT LED1
CURR UP 20
PACER LED
+5V PACE PANEL
PACER ON
PACER START/STOP
RATE DOWN
START/STOP LED
RATE UP
J24
+18V
+18V
+18V RETURN
+18V RETURN
ECG CLOCK
ECG SERIAL
STROBE
RX
TX
QRS PULSE
DELAY QRS MARK
EYE CLOSE
PACE FAULT
PACER P/S SHUTDOWN
OFF/RESET
BATT LED1
+5V
BATT LED2
DIG GND
BATT LED3
+5V
TP3
TP4
TP7
TP8
TP9
TP11
TP12
TP2
TP5
TP14
U8
U4 8MHZ OSC
U29 DS1242 RTC
U6 HC595
U5C
U5B
U5D
U5A
U9 HC138
U11 ADC0804LCN
U12 GATE ARRAY SCX6212
U3A
U3B
U3C
U7A
RN1 10K
RN2 1K
RN3 1K
RN4 10K
R31 10K
R22 100
R23 100
R119 1K
R29 1K
R53 1K
R52 1K
R54 200
R55 200
R30 49.9K
R122
R19 1K
R20 20K
R9 4.75K
R8 1MEG
R6 47.5K
R7 24.9K
R5 47.5K
R21 150
R1 0 1/4W
R120 511
R51 15.4K
R47 511
R49 20K
C4 0.1UF
C5 1UF
C6 0.1UF
C59
C58
C15 22PF
C16 22PF
C26 25V 10UF
C27 100PF
C28 0.01UF
CR3 1N914B
CR5 1N914B
CR18 1N914B
CR19 1N914B
-20,-21 only
SERIAL/ PARALLEL ECG INPUT DATA
ECG IN CS
ECG SERIAL
ECG CLOCK STROBE
RTC/ RAM
D<7..0>
0 (+18V) N18/3
MOTOR ON P.S. ON N3/3
MOTOR STALL N6/3
+18V N1/3
P.H AUTO CAL N19/3
VHD (+18V) N4/3
VHD (RET) N5/3
+12V N7/3
MOTOR (-) N8/3
MOTOR (+) N9/3
J37 BATT(-)
J23
MOTOR(-)
VHD(RET)
MOTOR(+)
VHD(RET)
VHD(RET)
THERM1
VHD(RET)
THERM2
ESD GND
VSS
VDD
D1
SB1
SB2
LD
CLK
VHD(+18V)
VHD(+18V)
VHD(+18V)
VHD(+18V)
P.H TYPE
EMITT.CAT.
SENSOR GND
SENSOR COLL
EMITT.ANO
PACER P/S SHUT DOWN N10/4
PACING PAD STATUS N11/4
PACER PULSE N13/4
PWM AMPLITUDE N12/4
+12V N7/4
0 (+18V) N18/4
VCC
NC

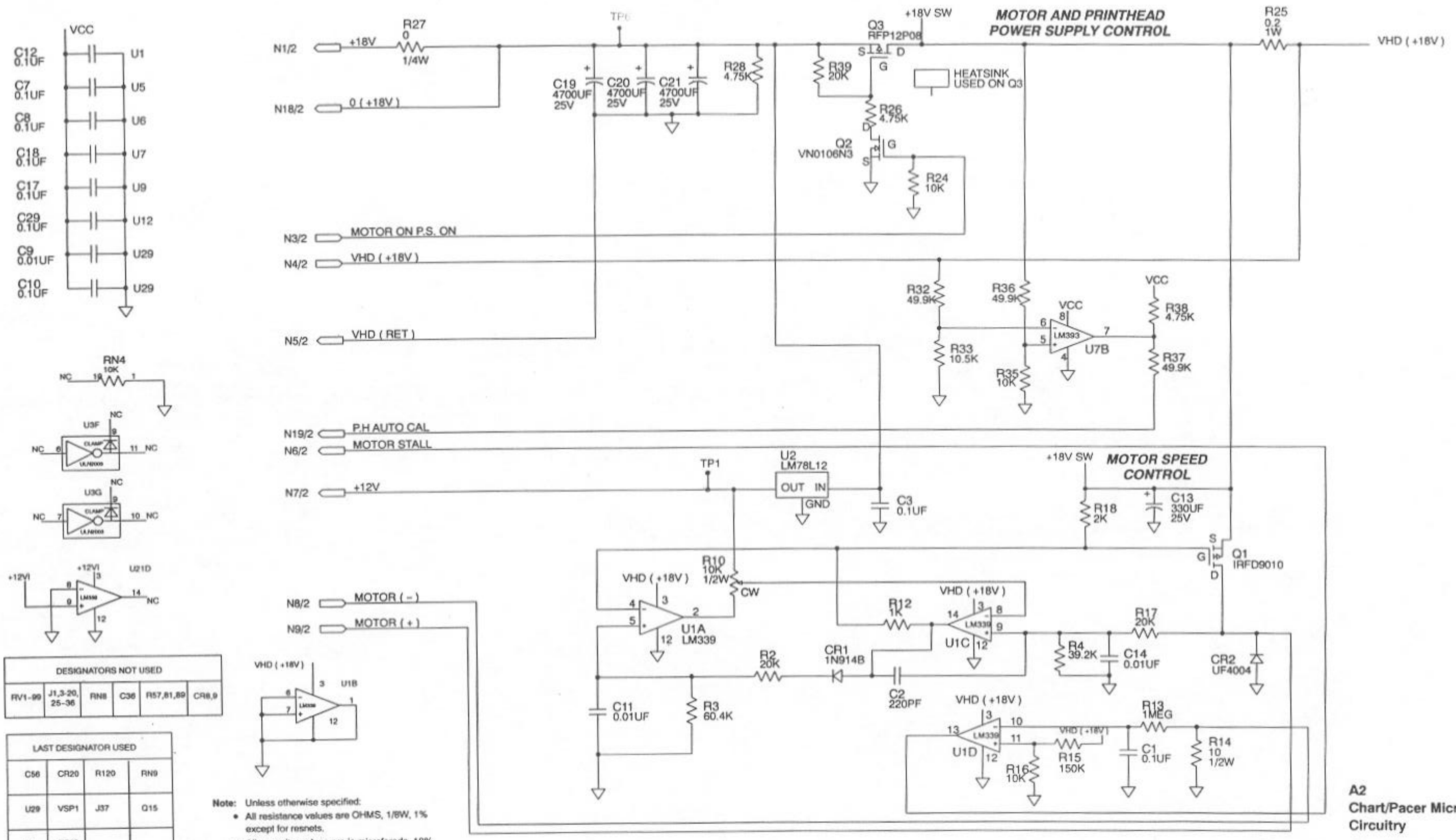
Note: Unless otherwise specified:

- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

SHIELD WIRE (-- --) FROM R54, R55 TO J23-12, J23-16

A2
Chart/Pacer Microcomputer Circuitry

Figure 5-5 Chart/Pacer PCB Assembly
Part Number 804202
(Sheet 2 of 5)


MOTOR AND PRINTHEAD POWER SUPPLY CONTROL
MOTOR SPEED CONTROL
VCC
C12 0.1UF U1
C7 0.1UF U5
C8 0.1UF U6
C18 0.1UF U7
C17 0.1UF U9
C29 0.1UF U12
C9 0.01UF U29
C10 0.1UF U29
RN4 10K
NC 16 1
U3F 9 11 NC 6 NC
U3G 9 10 NC 7 NC
ULN2003
CLAMP
+12VI U21D 3 8 9 14 NC 12
LM339
N1/2 +18V
R27 0 1/4W
N18/2 0 (+18V)
N3/2 MOTOR ON P.S. ON
N4/2 VHD (+18V)
N5/2 VHD (RET)
N19/2 P.H AUTO CAL
N6/2 MOTOR STALL
N7/2 +12V
N8/2 MOTOR (-)
N9/2 MOTOR (+)
TP6
C19 4700UF 25V
C20 4700UF 25V
C21 4700UF 25V
R28 4.75K
Q3 RFP12P08
+18V SW
S D G
R39 20K
R26 4.75K
Q2 VN0106N3
R24 10K
HEATSINK USED ON Q3
R25 0.2 1W
VHD (+18V)
R32 49.9K
R33 10.5K
R36 49.9K
R35 10K
VCC
U7B LM393 8 6 5 4 7
R38 4.75K
R37 49.9K
TP1
U2 LM78L12
OUT IN GND
C3 0.1UF
+18V SW
R18 2K
C13 330UF 25V
Q1 IRFD9010
S G D
R10 10K 1/2W CW
VHD (+18V)
U1A LM339 4 5 3 2 12
R12 1K
U1C LM339 14 3 8 9 12
R17 20K
R4 39.2K
C14 0.01UF
CR2 UF4004
R2 20K
CR1 1N914B
C2 220PF
C11 0.01UF
R3 60.4K
U1D LM339 13 3 10 11 12
R13 1MEG
R15 150K
R16 10K
C1 0.1UF
R14 10 1/2W
U1B LM339 3 6 7 1 12

DESIGNATORS NOT USED					
RV1-99	J1,3-20, 25-36	RN8	C36	R57,81,89	CR8,9

LAST DESIGNATOR USED			
C56	CR20	R120	RN9
U29	VSP1	J37	Q15
T1	TP28		

Note: Unless otherwise specified:
- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

Figure 5-5 **A2 Chart/Pacer Microcomputer Circuitry**
Chart/Pacer PCB Assembly
Part Number 804202
(Sheet 3 of 5)

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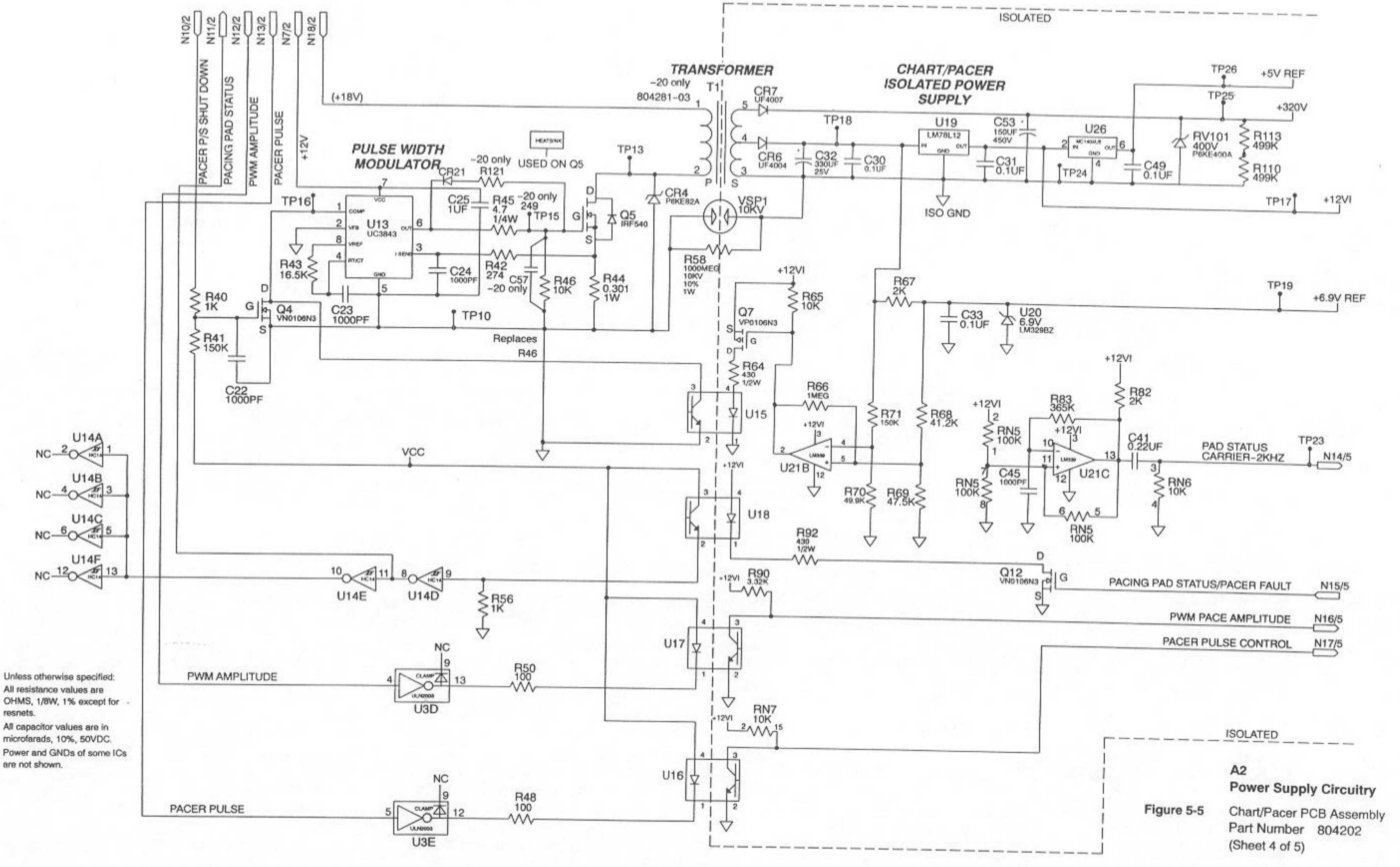
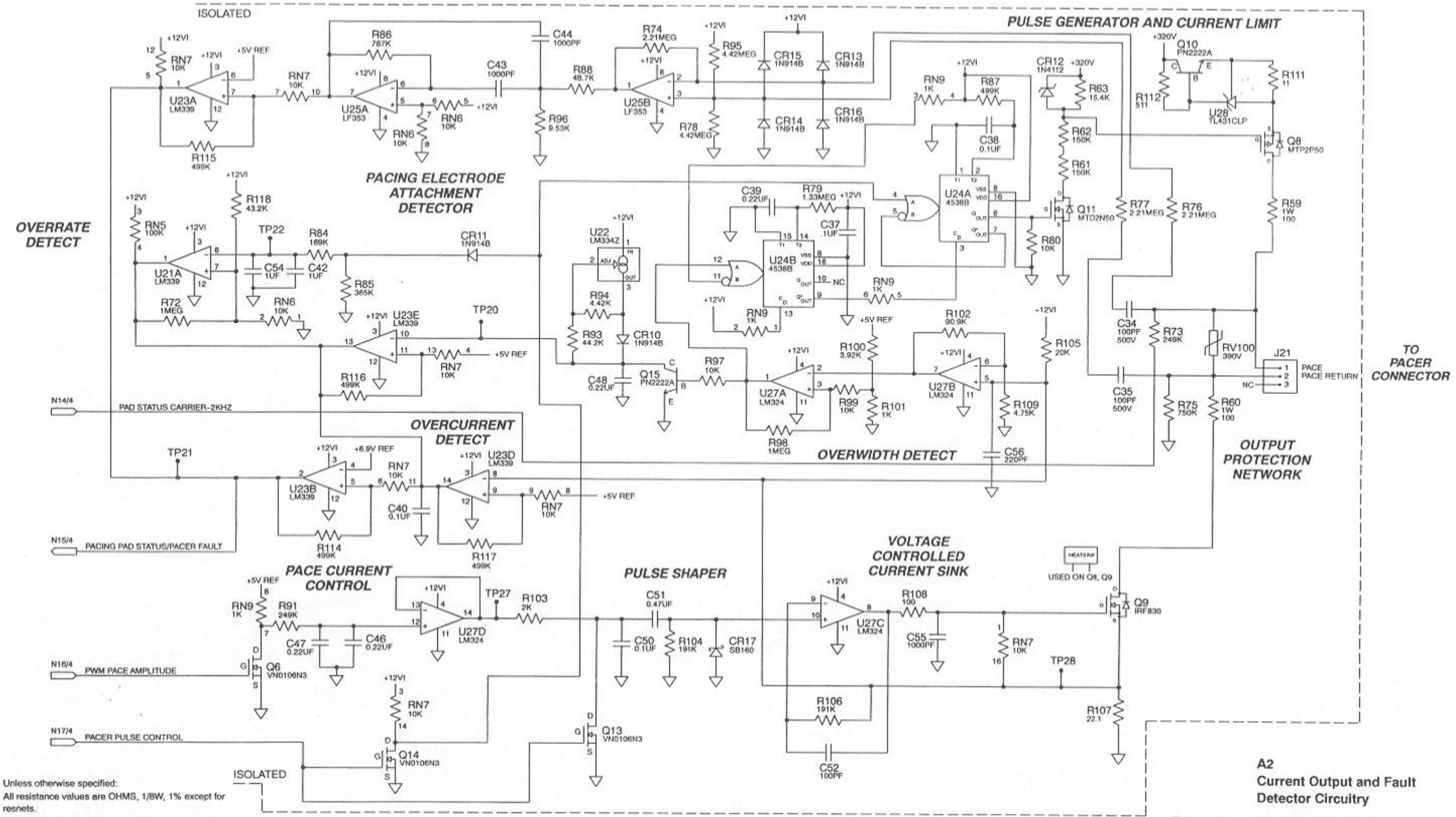

ISOLATED
TRANSFORMER
-20 only
804281-03
T1
CHART/PACER ISOLATED POWER SUPPLY
PULSE WIDTH MODULATOR
N10/2
N11/2
N12/2
N13/2
N7/2
N18/2
PACER P/S SHUT DOWN
PACING PAD STATUS
PWM AMPLITUDE
PACER PULSE
+12V
(+18V)
U13 UC3843
TP16
R43 16.5K
R40 1K
R41 150K
Q4 VN0106N3
C22 1000PF
C23 1000PF
C25 1UF
CR21
-20 only R121
R45 4.7 1/4W
-20 only 249
TP15
HEATSINK
USED ON Q5
R42 274
C57 -20 only
C24 1000PF
R46 10K
Replaces R46
TP10
TP13
Q5 IRF540
R44 0.301 1W
CR4 P6KE82A
VSP1 10KV
R58 1000MEG 10KV 10% 1W
CR7 UF4007
CR6 UF4004
C32 330UF 25V
C30 0.1UF
TP18
U19 LM78L12
ISO GND
C53 150UF 450V
C31 0.1UF
U26
TP24
C49 0.1UF
RV101 400V P6KE400A
R113 499K
R110 499K
TP26
TP25
+5V REF
+320V
TP17
+12VI
R67 2K
C33 0.1UF
U20 6.9V LM329BZ
TP19
+6.9V REF
Q7 VP0106N3
R65 10K
R64 430 1/2W
U15
R66 1MEG
U21B
R71 150K
R68 41.2K
R70 49.9K
R69 47.5K
RN5 100K
C45 1000PF
R83 365K
U21C
R82 2K
C41 0.22UF
RN6 10K
PAD STATUS CARRIER-2KHZ
TP23
N14/5
VCC
U18
R92 430 1/2W
Q12 VN0106N3
PACING PAD STATUS/PACER FAULT
N15/5
R90 3.32K
PWM PACE AMPLITUDE
N16/5
PACER PULSE CONTROL
N17/5
U17
RN7 10K
U16
U14A
U14B
U14C
U14F
U14E
U14D
NC
R56 1K
U3D
U3E
R50 100
R48 100
CLAMP
PWM AMPLITUDE
PACER PULSE

Note: Unless otherwise specified:
- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

Figure 5-5 **A2 Power Supply Circuitry**
Chart/Pacer PCB Assembly
Part Number 804202
(Sheet 4 of 5)


ISOLATED
PULSE GENERATOR AND CURRENT LIMIT
OVERRATE DETECT
PACING ELECTRODE ATTACHMENT DETECTOR
OVERCURRENT DETECT
OVERWIDTH DETECT
PACE CURRENT CONTROL
PULSE SHAPER
VOLTAGE CONTROLLED CURRENT SINK
OUTPUT PROTECTION NETWORK
TO PACER CONNECTOR
J21
PACE
PACE RETURN
NC
N14/4 PAD STATUS CARRIER-2KHZ
N15/4 PACING PAD STATUS/PACER FAULT
N16/4 PWM PACE AMPLITUDE
N17/4 PACER PULSE CONTROL
U23A LM339
U25A LF353
U25B LF353
U21A LM339
U23E LM339
U22 LM334Z
U24A 4538B
U24B 4538B
U27A LM324
U27B LM324
U23B LM339
U23D LM339
U27D LM324
U27C LM324
Q10 PN2222A
U28 TL431CLP
Q8 MTP2P50
Q11 MTD2N50
Q15 PN2222A
Q6 VN0106N3
Q13 VN0106N3
Q14 VN0106N3
Q9 IRF830
RV100 390V
HEATSINK
USED ON Q8, Q9
TP20
TP21
TP22
TP27
TP28
+12VI
+5V REF
+6.9V REF
+320V

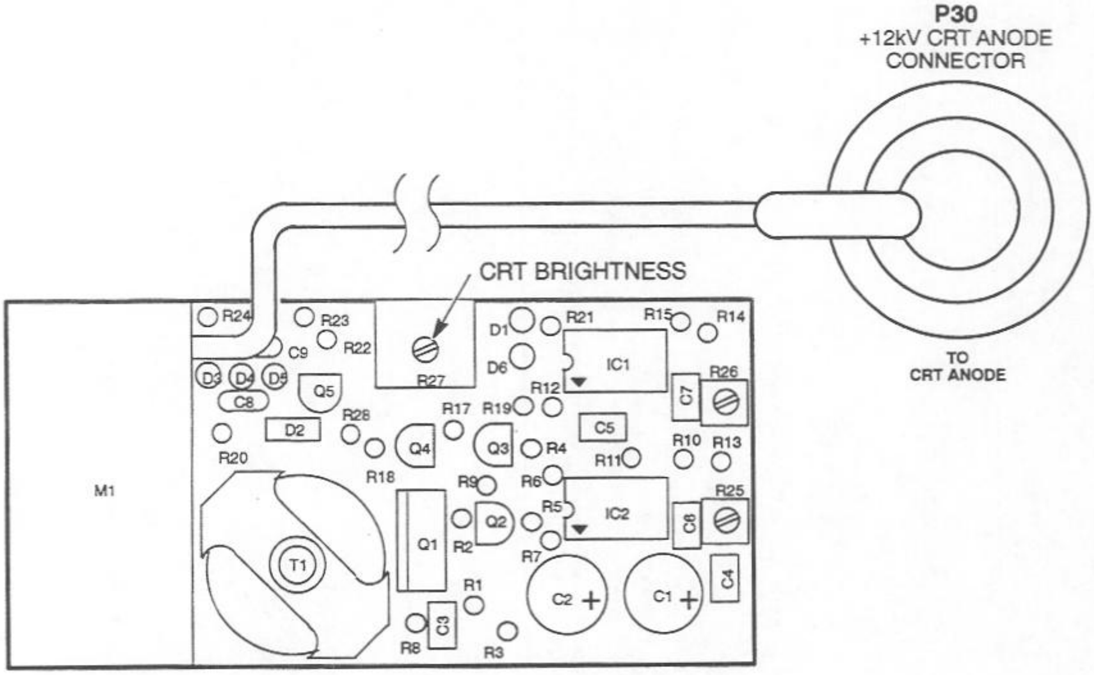
A2
Current Output and Fault Detector Circuitry

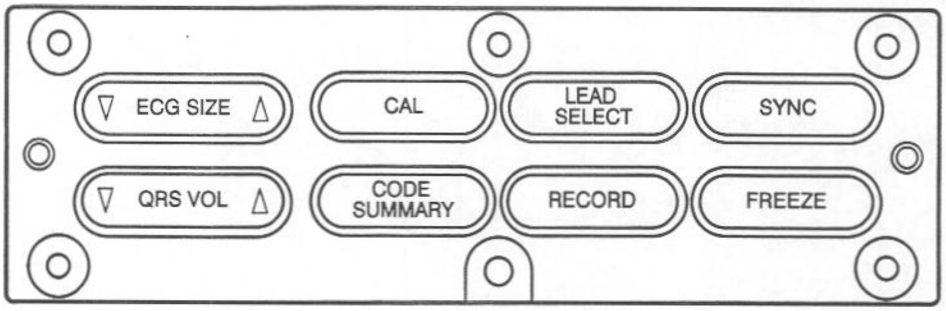
Figure 5-5 Chart/Pacer PCB Assembly
Part Number 804202
(Sheet 5 of 5)

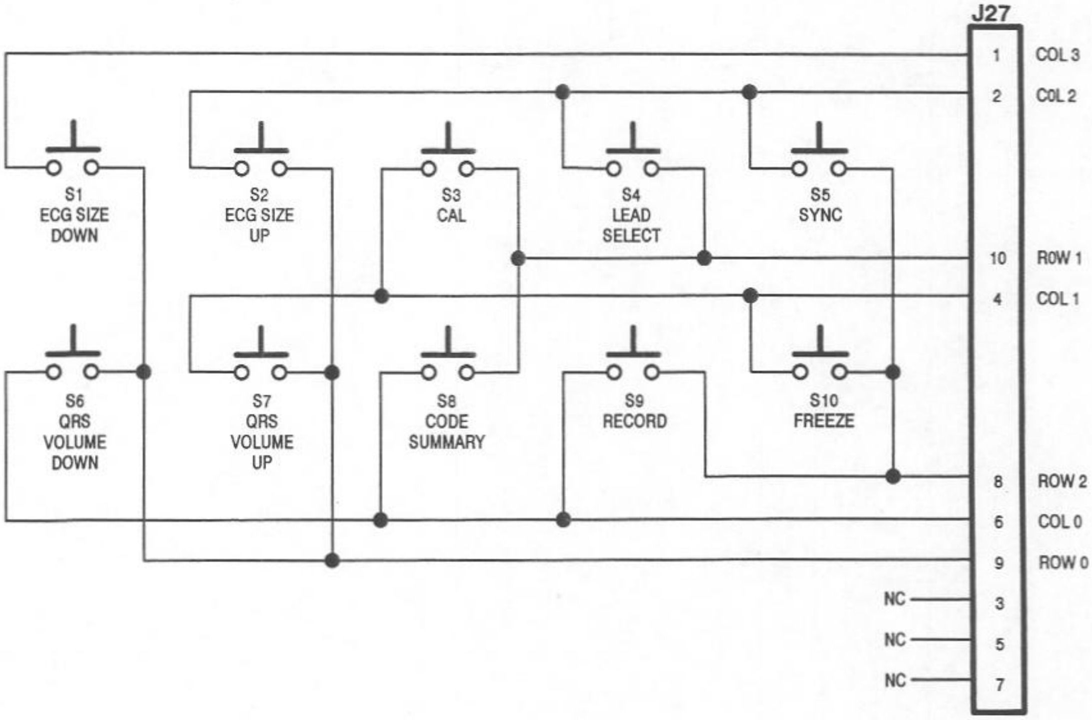
Note: Unless otherwise specified:
- All resistance values are OHMS, 1/8W, 1% except for resnets.
- All capacitor values are in microfarads, 10%, 50VDC.
- Power and GNDs of some ICs are not shown.

A3

Figure 5-6 Anode Power Supply
Part Number 804296
(Sheet 1 of 1)

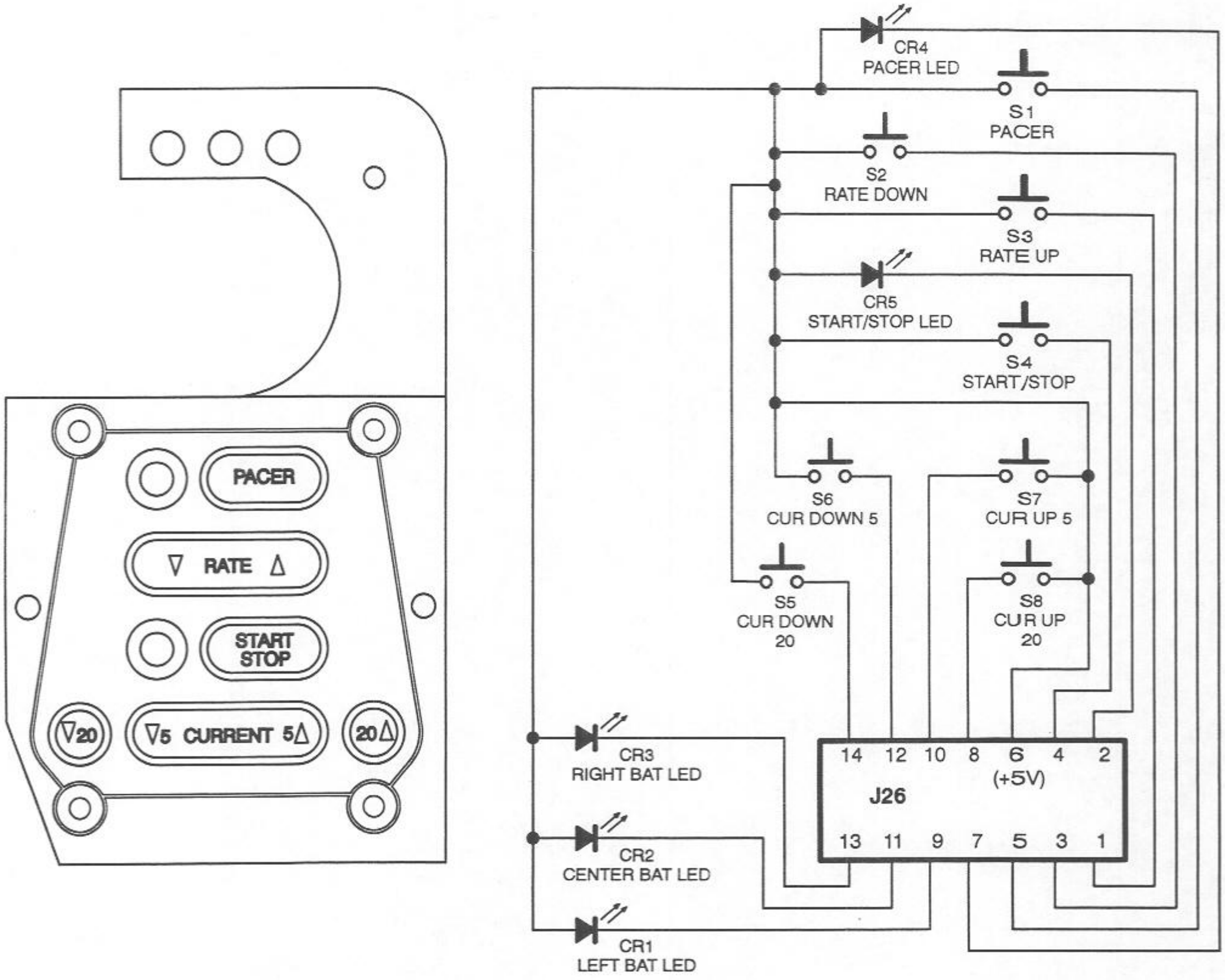

P30
+12kV CRT ANODE
CONNECTOR
TO
CRT ANODE
CRT BRIGHTNESS
M1
R24
R23
C9
R22
D3
D4
D5
C8
Q5
R28
D2
R20
R18
T1
Q1
R27
D1
D6
R21
R15
R14
IC1
R12
R26
C7
R17
R19
Q4
Q3
R4
C5
R10
R13
R11
R9
R6
R25
R5
IC2
C6
Q2
R2
R7
R1
C2
C1
C4
C3
R8
R3


▽ ECG SIZE △
CAL
LEAD SELECT
SYNC
▽ QRS VOL △
CODE SUMMARY
RECORD
FREEZE


J27
1 COL 3
2 COL 2
10 ROW 1
4 COL 1
8 ROW 2
6 COL 0
9 ROW 0
NC 3
NC 5
NC 7
S1 ECG SIZE DOWN
S2 ECG SIZE UP
S3 CAL
S4 LEAD SELECT
S5 SYNC
S6 QRS VOLUME DOWN
S7 QRS VOLUME UP
S8 CODE SUMMARY
S9 RECORD
S10 FREEZE

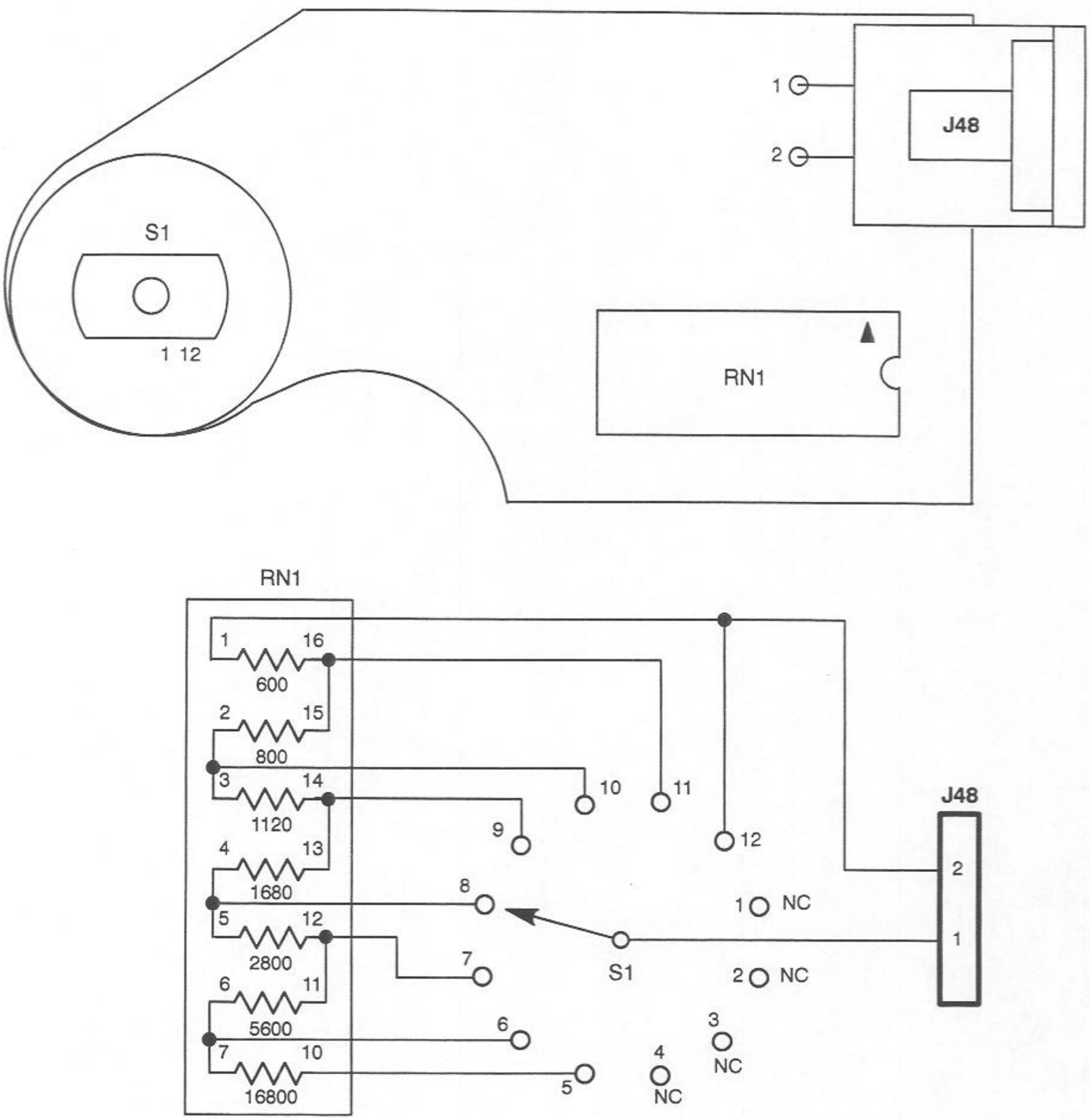
A4

Figure 5-7 Main Control Panel Assembly
Part Number 804277
(Sheet 1 of 1)


PACER
∇ RATE ∆
START STOP
∇20
∇5 CURRENT 5∆
20∆
CR4
PACER LED
S1
PACER
S2
RATE DOWN
S3
RATE UP
CR5
START/STOP LED
S4
START/STOP
S6
CUR DOWN 5
S7
CUR UP 5
S5
CUR DOWN
20
S8
CUR UP
20
CR3
RIGHT BAT LED
CR2
CENTER BAT LED
CR1
LEFT BAT LED
J26
14 12 10 8 6 4 2
(+5V)
13 11 9 7 5 3 1

A5

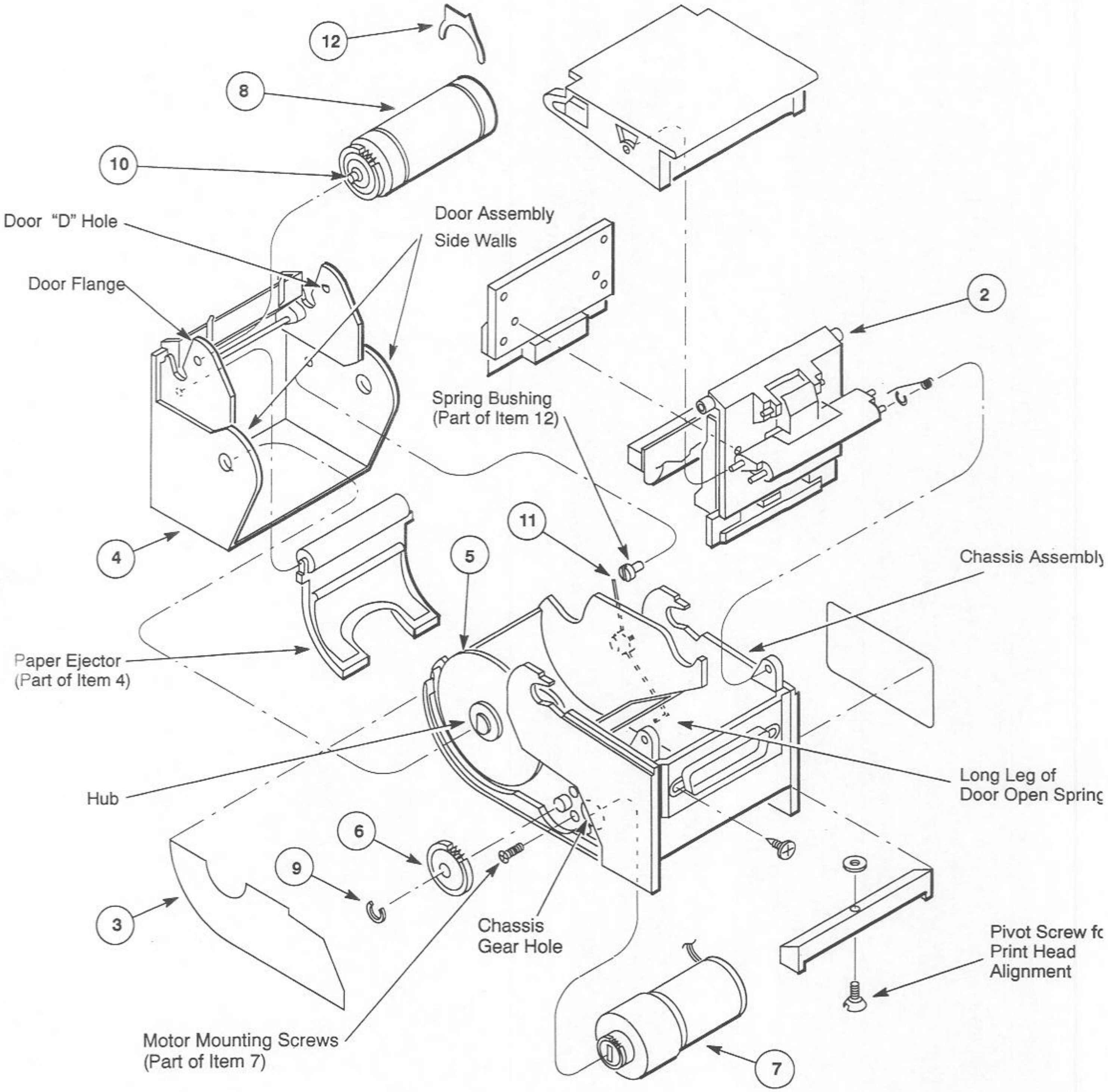
Figure 5-8 Pacer Control/Battery Indicator Panel Assembly
Part Number 804196
(Sheet 1 of 1)


1
2
J48
S1
1 12
RN1
RN1
1
16
600
2
15
800
3
14
1120
4
13
1680
5
12
2800
6
11
5600
7
10
16800
10
11
9
12
J48
2
8
1 NC
S1
1
7
2 NC
6
3
NC
4
NC
5

A6

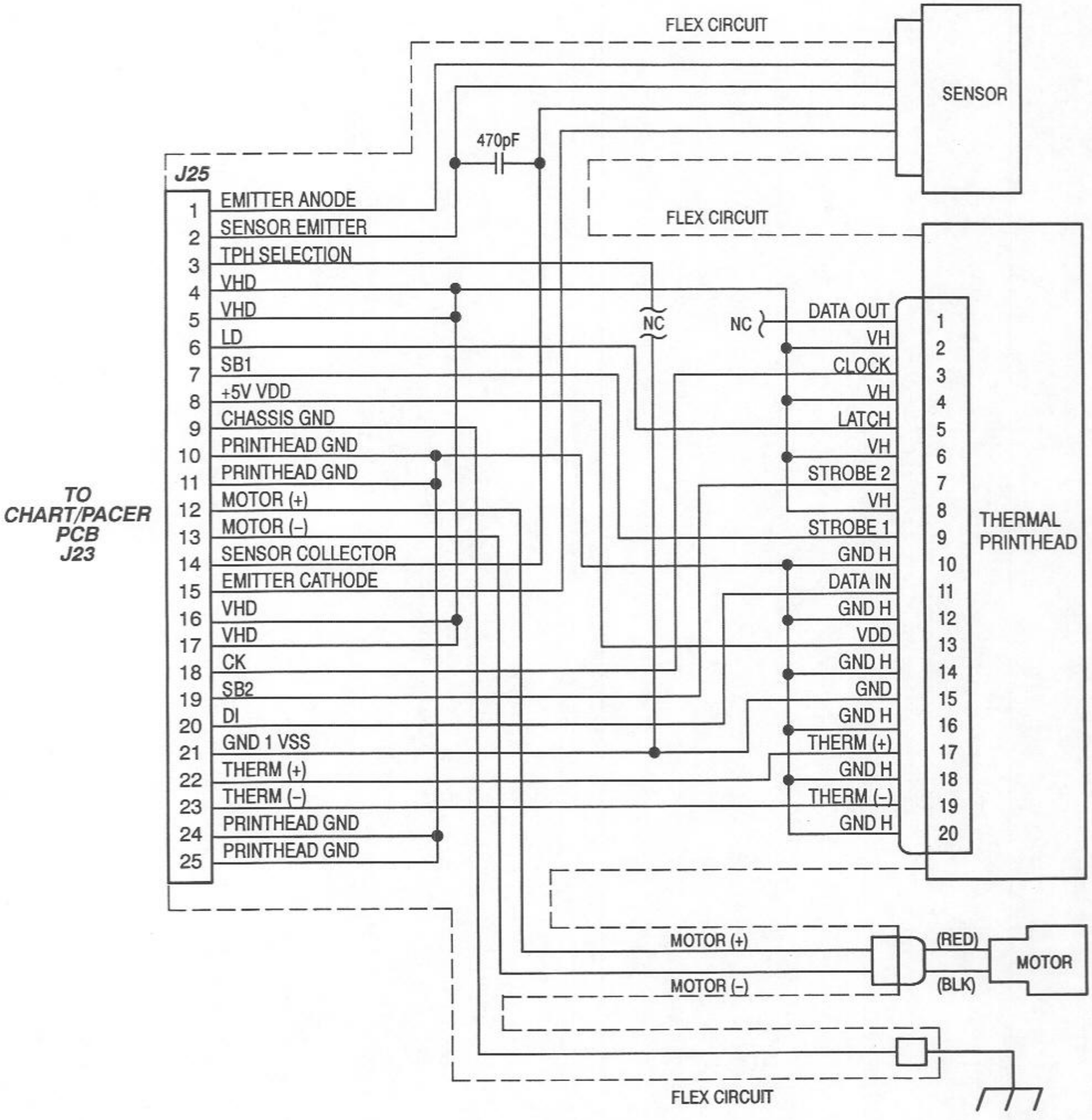
Figure 5-9 Energy Select PCB Assembly
Part Number 804258
(Sheet 1 of 1)

5-10 Ref	Part Number	Description	Used On	Qty
A7	804189-00	**Recorder Assembly**	804200-28 thru 41, 59, 62, 63	REF
2	806752-30	**Bumper**, printhead		2
3	806752-38	**Cover**, gear (Also included with Motor Assembly. Includes Ejector)		1
4	806752-73	**Door**, Assembly, White		1
	806752-74	**Door**, Assembly, Amber		1
5	806752-50	**Gear**, idler 108T		1
6	806752-48	**Gear**, motor 31T		1
7	806752-72	**Motor Assembly/Gear** (Includes Locktite mounting screws and gear cover)		1
8	806752-10	**Printroller Assembly** (Includes gear)		1
9	806752-69	**Retaining Ring**		1
10	806752-44	**Shaft Roller**		1
11	806752-28	**Spring Assembly,** Door Open		1
12	806752-70	**Stripper**, Paper		2
REF	806752-71	**Pad**, Anti-static		2


12
8
10
Door "D" Hole
Door Flange
Door Assembly
Side Walls
2
Spring Bushing
(Part of Item 12)
11
4
5
Chassis Assembl
Paper Ejector
(Part of Item 4)
Hub
Long Leg of
Door Open Sprinc
6
9
3
Chassis
Gear Hole
Pivot Screw fc
Print Head
Alignment
Motor Mounting Screws
(Part of Item 7)
7

A7

Figure 5-10 Recorder Assembly
Part Number 804189-00, 01
(Sheet 1 of 2)

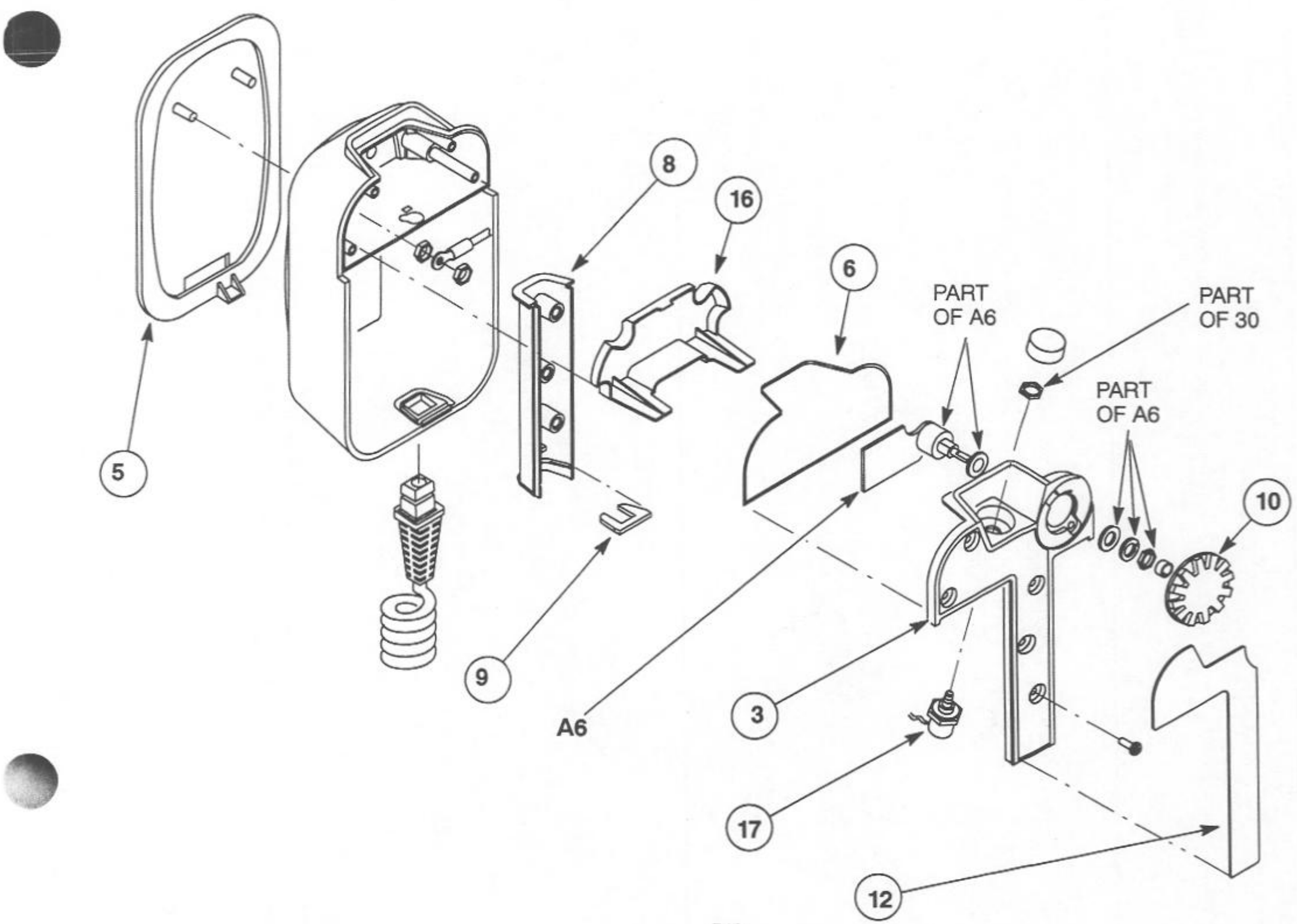

FLEX CIRCUIT
SENSOR
470pF
J25
1 EMITTER ANODE
2 SENSOR EMITTER
3 TPH SELECTION
4 VHD
5 VHD
6 LD
7 SB1
8 +5V VDD
9 CHASSIS GND
10 PRINTHEAD GND
11 PRINTHEAD GND
12 MOTOR (+)
13 MOTOR (–)
14 SENSOR COLLECTOR
15 EMITTER CATHODE
16 VHD
17 VHD
18 CK
19 SB2
20 DI
21 GND 1 VSS
22 THERM (+)
23 THERM (–)
24 PRINTHEAD GND
25 PRINTHEAD GND
TO CHART/PACER PCB J23
FLEX CIRCUIT
NC
NC
DATA OUT 1
VH 2
CLOCK 3
VH 4
LATCH 5
VH 6
STROBE 2 7
VH 8
STROBE 1 9
GND H 10
DATA IN 11
GND H 12
VDD 13
GND H 14
GND 15
GND H 16
THERM (+) 17
GND H 18
THERM (–) 19
GND H 20
THERMAL PRINTHEAD
MOTOR (+)
MOTOR (–)
(RED)
(BLK)
MOTOR
FLEX CIRCUIT

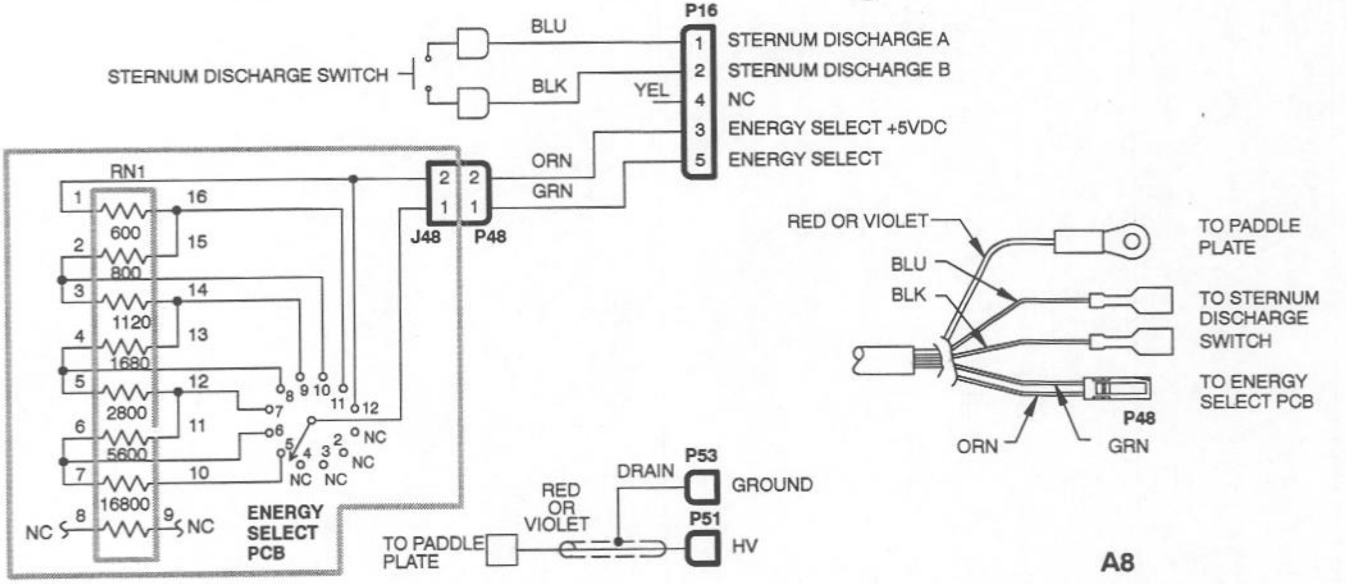
A7

Figure 5-10 Recorder Assembly
Part Number 804189-00
(Sheet 2 of 2)

5-11 Ref	Part Number	Description	Used On	Qty
A8	804250-11	**Paddle Assembly,** Sternum, English	804200-28, 33, 59, 62, 63	1
	804250-12	**Paddle Assembly**, Apex, English	804200-28, 33, 59, 62, 63	1
	804250-13	**Paddle Assembly**, Sternum, French	804200-30, 35, 40, 41	1
	804250-14	**Paddle Assembly**, Apex, French	804200-30, 35, 40, 41	1
	804250-15	**Paddle Assembly**, Sternum, German	804200-29, 34	1
	804250-16	**Paddle Assembly**, Apex, German	804200-29, 34	1
	804250-17	**Paddle Assembly**, Sternum, Spanish	804200-31, 36	1
	804250-18	**Paddle Assembly**, Apex, Spanish	804200-31, 36	1
	804250-19	**Paddle Assembly,** Sternum, English, IEC	804200-32, 37, 38, 39	1
	804250-20	**Paddle Assembly**, Apex, English, IEC	804200-32, 37, 38, 39	1
	804250-23	**Paddle Assembly,** Sternum, Polish	804200-66	1
	804250-24	**Paddle Assembly**, Apex, Polish	804200-66	1
		Replaceable Components in 804250:		
A6	804258-02	**Energy Select PCB Assembly**	804250-11, 13, 15, 17, 19	1
2	804246-02	**Cover,** Apex Paddle	804250-12, 14, 16, 18, 20	1
3	804246-03	**Cover,** Sternum Paddle	-11, 13, 15, 17, 19	1
4	802902-04	**Electrode Plate Assembly**, Apex Paddle	-12, 14, 16, 18, 20	1
5	802902-05	**Electrode Plate Assembly**, Sternum Paddle	-11, 13, 15, 17, 19	1
6	802944-01, 02	**Gasket,** Paddle	-11 thru 20	1
7	802931-02	**Handle,** Paddle, Apex	-12, 14, 16, 18, 20	1
8	802931-03	**Handle,** Paddle, Sternum	-11, 13, 15, 17, 19	1
9	802932-00	**Key**, Retainer, Coil Cord	-11 thru 20	1
10	804248-00	**Knob,** Energy Select	-11, 13, 15, 17, 19	1
11	804267-02	**Label**, Paddle Apex, English	-12, 14, 16, 18, 20	1
	804267-03	**Label**, Paddle Apex, Polish	-24	1
12	804268-08	**Label**, Paddle, Sternum, English	-11, 13, 15, 17, 19	1
	804268-12	**Label**, Paddle, Sternum, Polish	-23	1
13	800819-43	**Label,** Serial Number, Paddle, Sternum, English (Not shown)	-11	1
	800819-45	**Label,** Serial Number, Paddle, Sternum, French (Not shown)	-13	1
	800819-47	**Label,** Serial Number, Paddle, Sternum, German (Not shown)	-15	1
	800819-49	**Label,** Serial Number, Paddle, Sternum, Spanish (Not shown)	-17	1
	800819-51	**Label,** Serial Number, Paddle, Sternum, English, IEC (Not shown)	-19	1
	800819-128	**Label,** Serial Number, Paddle, Sternum, Polish (Not shown)	-23	1
	800819-42	**Label,** Serial Number, Paddle, Apex, English (Not shown)	-12	1
	800819-44	**Label,** Serial Number, Paddle, Apex, French (Not shown)	-14	1
	800819-46	**Label,** Serial Number, Paddle, Apex, German (Not shown)	-16	1
	800819-48	**Label,** Serial Number, Paddle, Apex, Spanish (Not shown)	-18	1

5-11 Ref	Part Number	Description	Used On	Qty
	800819-50	**Label,** Serial Number, Paddle, Apex, English, IEC (Not shown)	-20	1
	800819-129	**Label,** Serial Number, Paddle, Apex, Polish, IEC (Not shown)	-24	1
14	200491-048	**LED**, Yellow	-12, 14, 16, 18, 20	1
15	805241-00	**Seal**, LED, Apex Paddle	-12, 14, 16, 18, 20	1
16	804231-00	**Shield,** High Voltage	-11 thru 20	1
17	804697-03	**Switch,** Pushbutton, SPST	-12, 14, 16, 18, 20	3
	804697-03	**Switch,** Pushbutton, SPST	-11, 13, 15, 17, 19	1


8
16
6
PART OF A6
PART OF 30
PART OF A6
10
5
9
A6
3
17
12

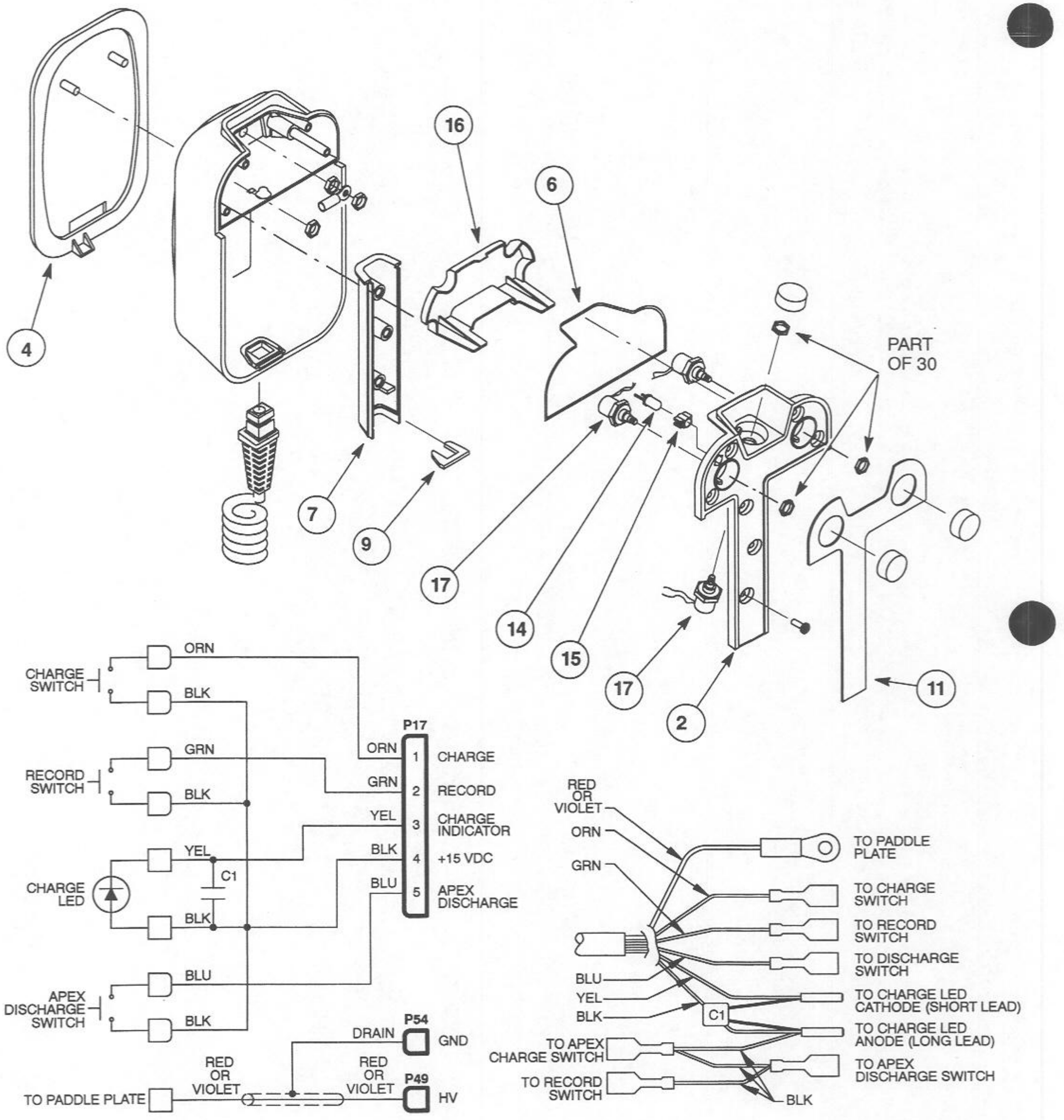

P16
BLU
STERNUM DISCHARGE SWITCH
BLK
YEL
1 STERNUM DISCHARGE A
2 STERNUM DISCHARGE B
4 NC
3 ENERGY SELECT +5VDC
5 ENERGY SELECT
ORN
GRN
J48
P48
RN1
600
800
1120
1680
2800
5600
16800
NC
ENERGY SELECT PCB
DRAIN
P53
GROUND
RED OR VIOLET
P51
HV
TO PADDLE PLATE
RED OR VIOLET
BLU
BLK
TO PADDLE PLATE
TO STERNUM DISCHARGE SWITCH
TO ENERGY SELECT PCB
P48
ORN
GRN

804250-11, 13, 15, 19, 23 STERNUM

A8

Figure 5-11 Paddle Assembly
Part Number 804250
(Sheet 1 of 2)

150

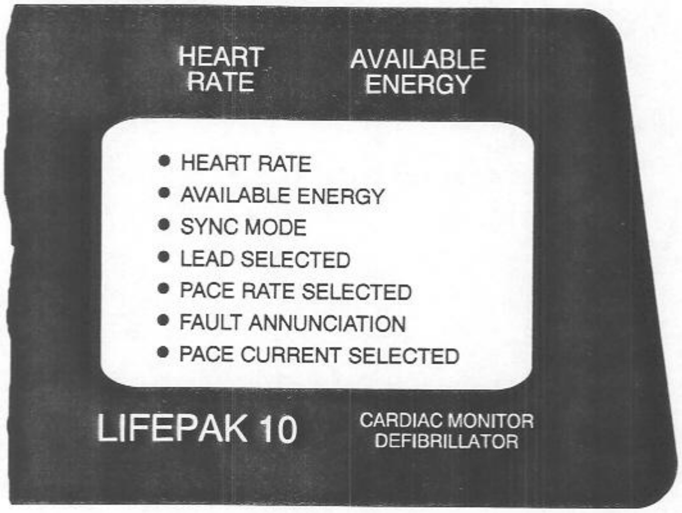

16
6
4
7
9
17
14
15
17
2
11
PART OF 30
CHARGE SWITCH
ORN
BLK
RECORD SWITCH
GRN
BLK
CHARGE LED
YEL
C1
BLK
APEX DISCHARGE SWITCH
BLU
BLK
P17
ORN
GRN
YEL
BLK
BLU
1 CHARGE
2 RECORD
3 CHARGE INDICATOR
4 +15 VDC
5 APEX DISCHARGE
TO PADDLE PLATE
RED OR VIOLET
DRAIN
P54
GND
RED OR VIOLET
P49
HV
RED OR VIOLET
ORN
GRN
TO PADDLE PLATE
TO CHARGE SWITCH
TO RECORD SWITCH
TO DISCHARGE SWITCH
BLU
YEL
BLK
C1
TO CHARGE LED CATHODE (SHORT LEAD)
TO CHARGE LED ANODE (LONG LEAD)
TO APEX CHARGE SWITCH
TO APEX DISCHARGE SWITCH
TO RECORD SWITCH
BLK

A8

804250-12, 14, 16, 18, 20, 24 APEX

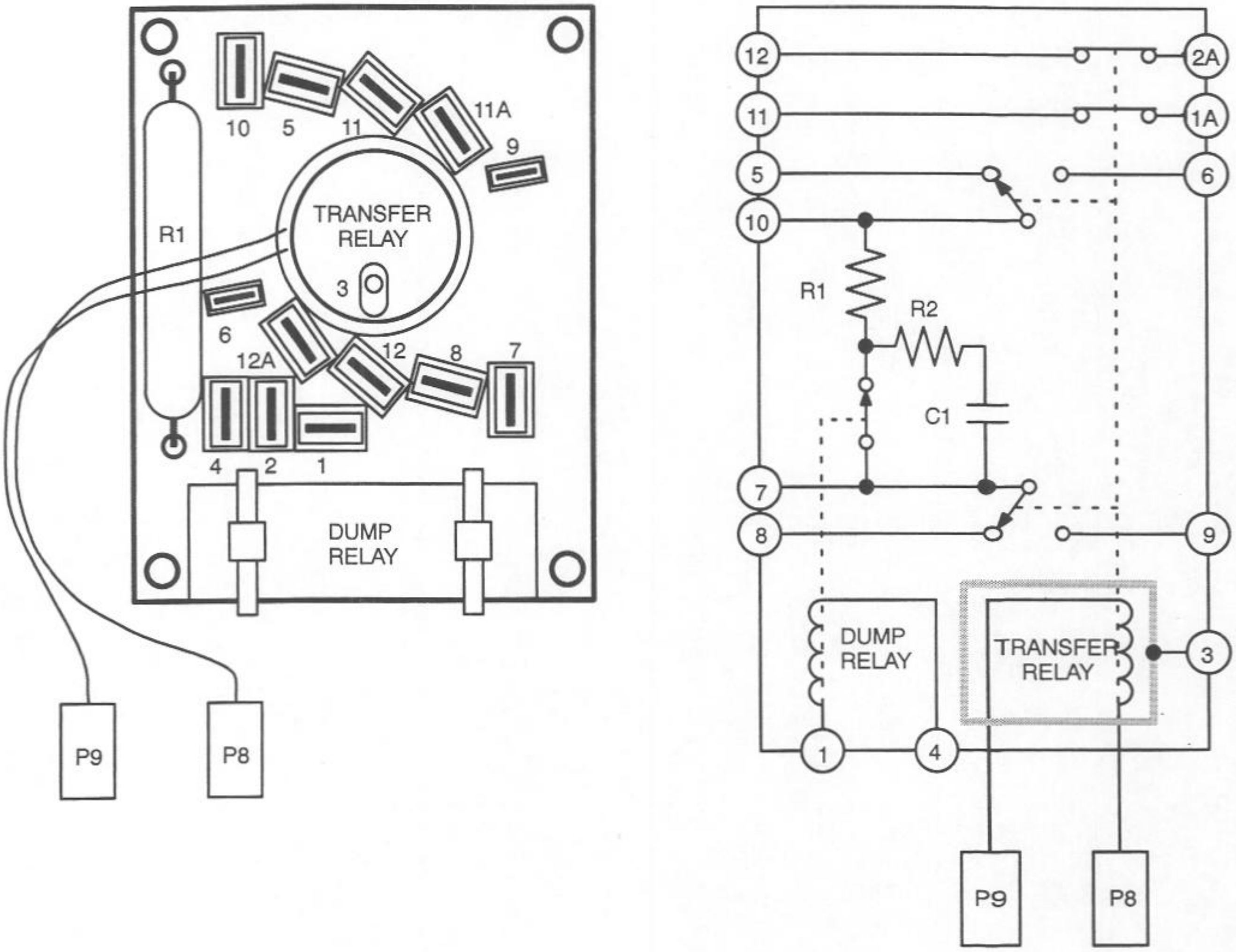
Figure 5-11 Paddle Assembly
Part Number 804250
(Sheet 2 of 2)

151


HEART RATE
AVAILABLE ENERGY
● HEART RATE
● AVAILABLE ENERGY
● SYNC MODE
● LEAD SELECTED
● PACE RATE SELECTED
● FAULT ANNUNCIATION
● PACE CURRENT SELECTED
LIFEPAK 10
CARDIAC MONITOR DEFIBRILLATOR

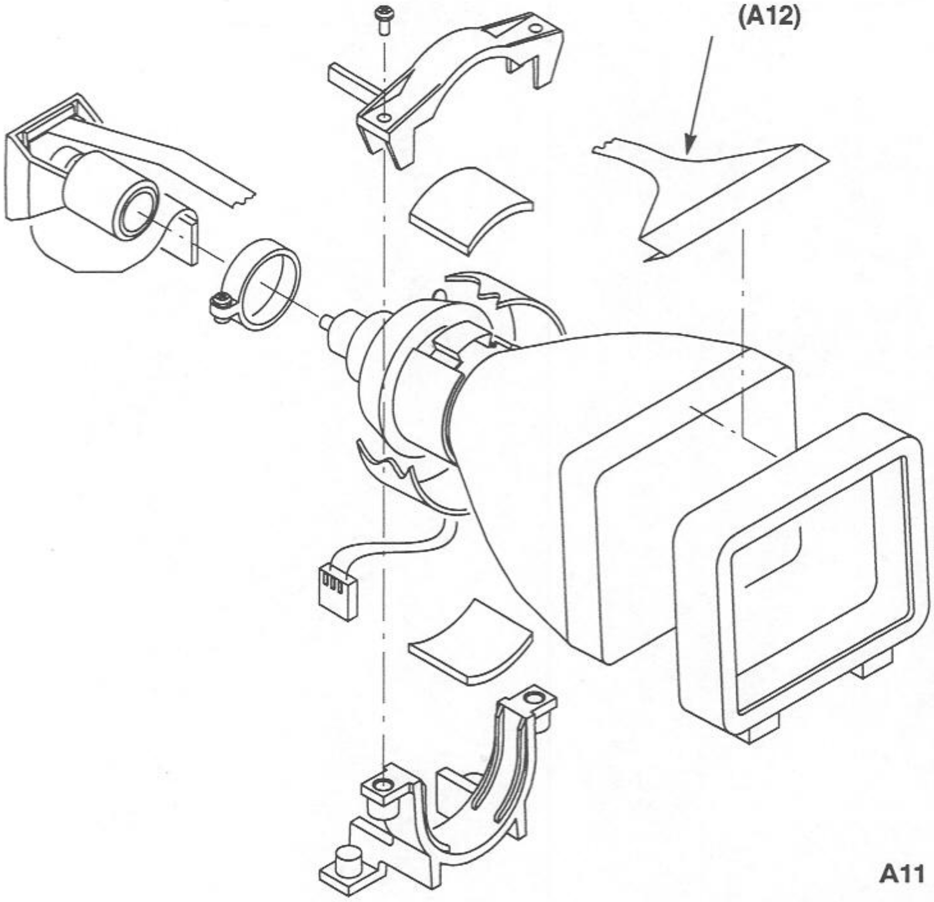
A9

Figure 5-12 Status Display Module
Part Number 805230
(Sheet 1 of 1)


10
5
11
11A
9
R1
TRANSFER RELAY
3
6
12A
12
8
7
4
2
1
DUMP RELAY
P9
P8
12
2A
11
1A
5
6
10
R1
R2
C1
7
8
9
DUMP RELAY
TRANSFER RELAY
3
1
4
P9
P8

A10

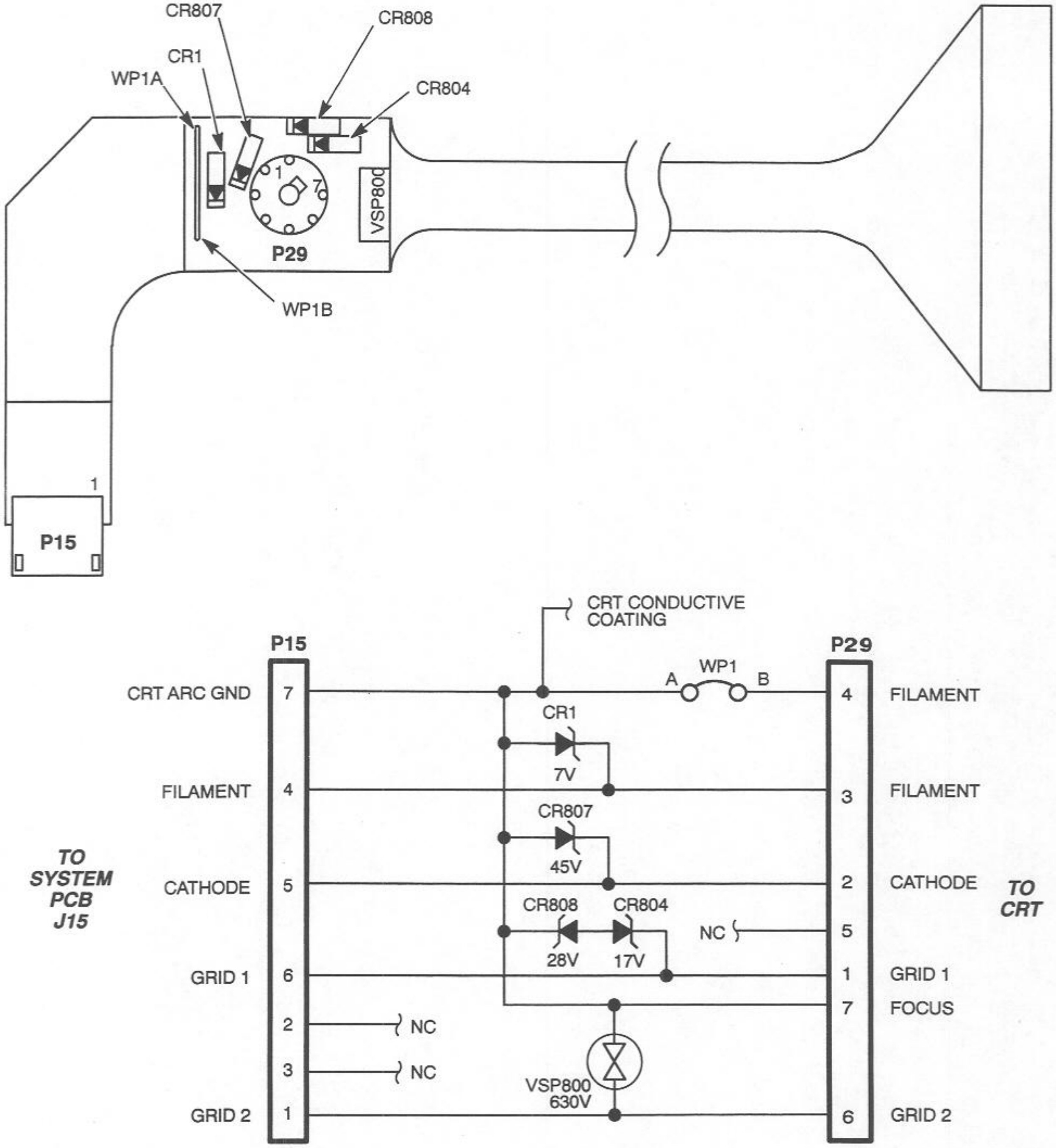
Figure 5-13 Relay Assembly
Part Number 800240
(Sheet 1 of 1)



A11

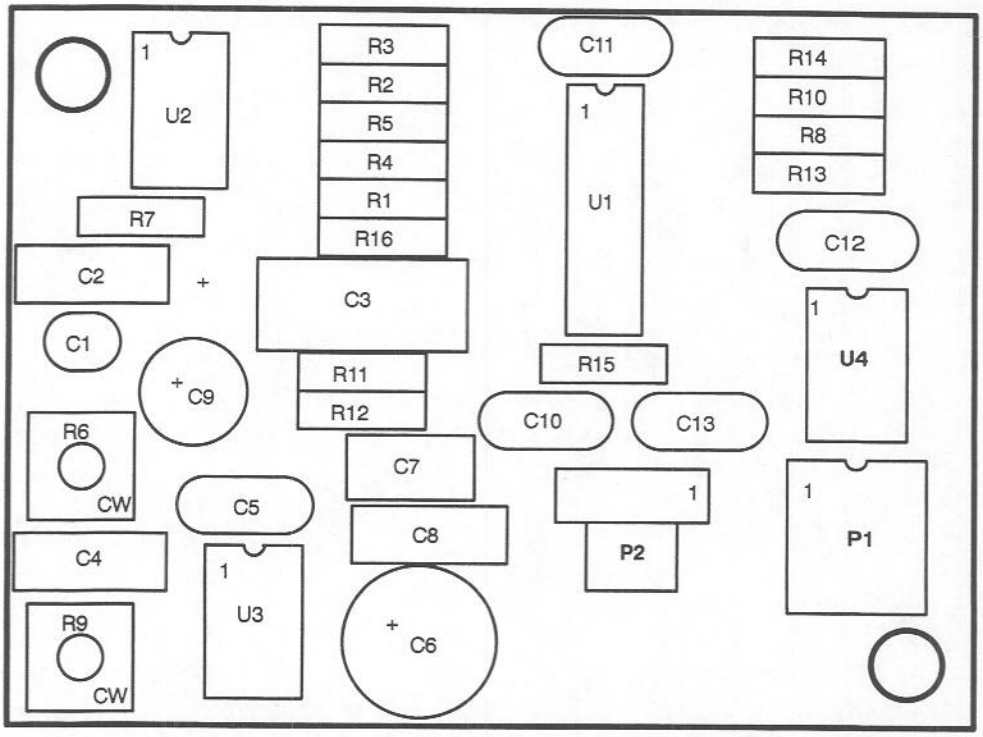
Figure 5-14 CRT Assembly
Part Number 806389
(Sheet 1 of 1)

154

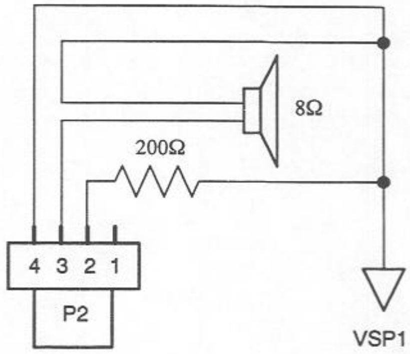

CR807
CR808
CR1
WP1A
CR804
VSP800
P29
WP1B
1
P15
CRT CONDUCTIVE COATING
P15
P29
WP1
A
B
CRT ARC GND
7
4
FILAMENT
CR1
7V
FILAMENT
4
3
FILAMENT
CR807
45V
TO SYSTEM PCB J15
CATHODE
5
2
CATHODE
TO CRT
CR808
CR804
NC
5
28V
17V
GRID 1
6
1
GRID 1
7
FOCUS
2
NC
3
NC
VSP800
630V
GRID 2
1
6
GRID 2

A12

Figure 5-15 CRT PFC Assembly
Part Number 805078
(Sheet 1 of 1)

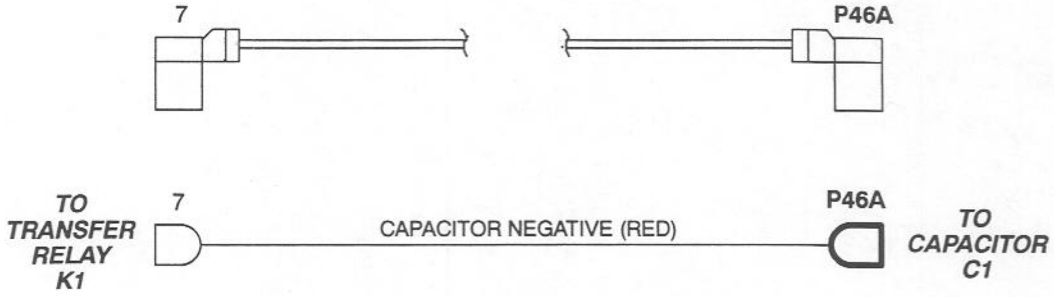

1
U2
R3
R2
R5
R4
R1
R16
C11
1
U1
R14
R10
R8
R13
C12
R7
C2
+
C3
C1
+
C9
R11
R12
R15
C10
C13
1
U4
R6
CW
C7
1
P2
1
P1
C5
C8
C4
1
U3
+
C6
R9
CW

NOTE: On circuit (non-component) side of PCB:
Item 2 (wire) connects R14 and U1 pin 1
Item 2 (wire) connects P1 pin 5 and U1 pin 3


8Ω
200Ω
4 3 2 1
P2
VSP1

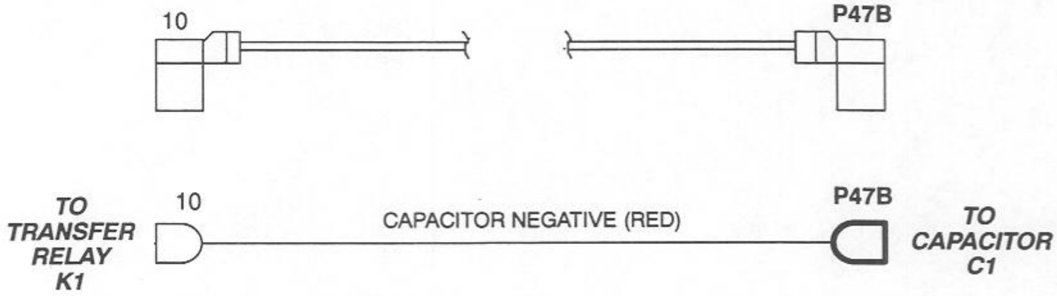
A15

Figure 5-16 MIEMSS Modulator PCB Assembly
Part Number 805608
(Sheet 1 of 1)


7
P46A
TO
TRANSFER
RELAY
K1
7
CAPACITOR NEGATIVE (RED)
P46A
TO
CAPACITOR
C1

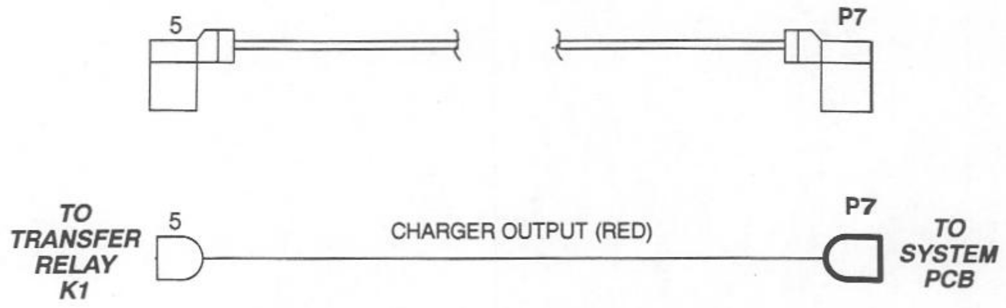
W1

Figure 5-17 Capacitor Negative-Relay Wire Harness
Part Number 805115-01


10
P47B
TO
TRANSFER
RELAY
K1
10
CAPACITOR NEGATIVE (RED)
P47B
TO
CAPACITOR
C1

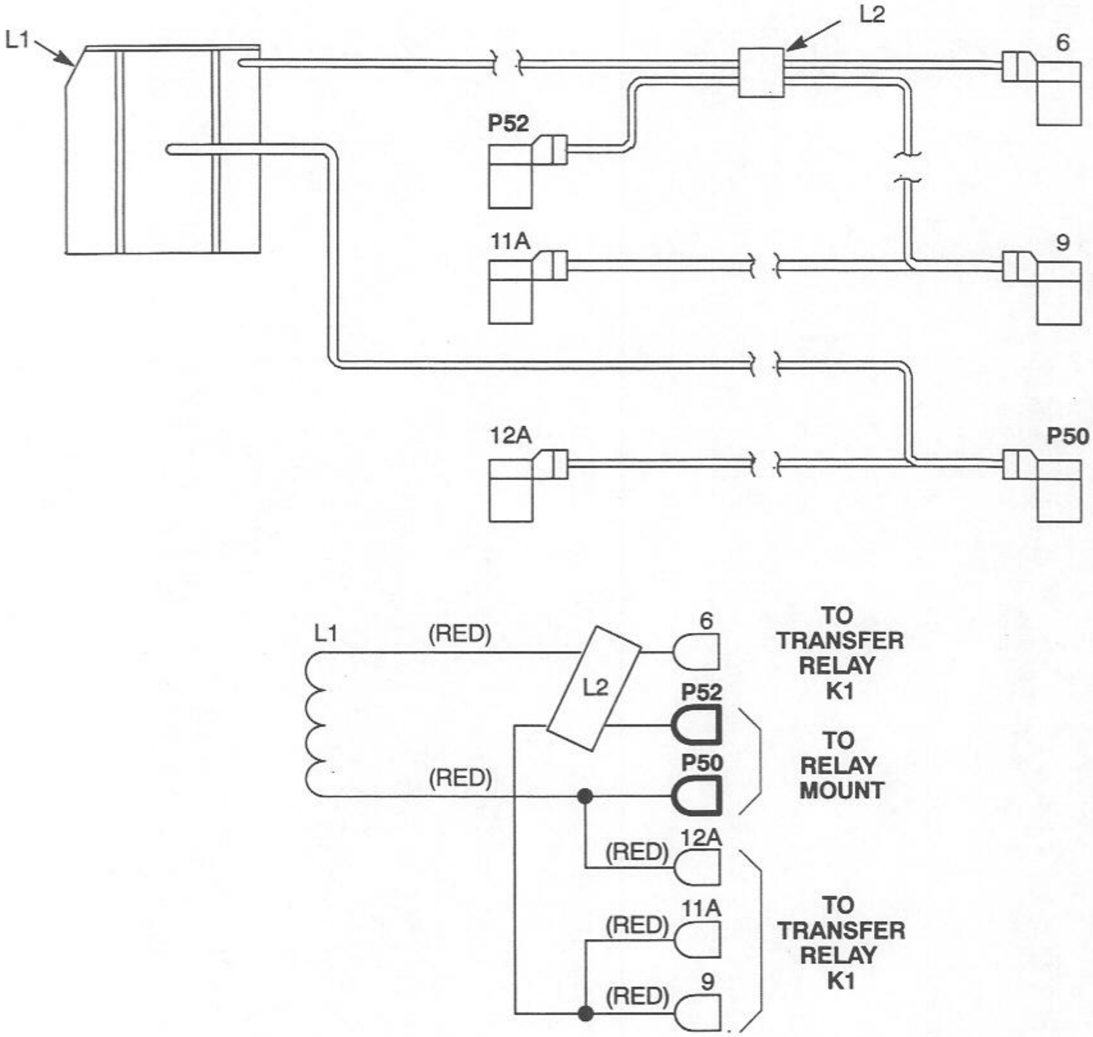
W2

Figure 5-18 Capacitor Positive-Relay Wire Harness
Part Number 805115-02


5
P7
TO TRANSFER RELAY K1
5
CHARGER OUTPUT (RED)
P7
TO SYSTEM PCB

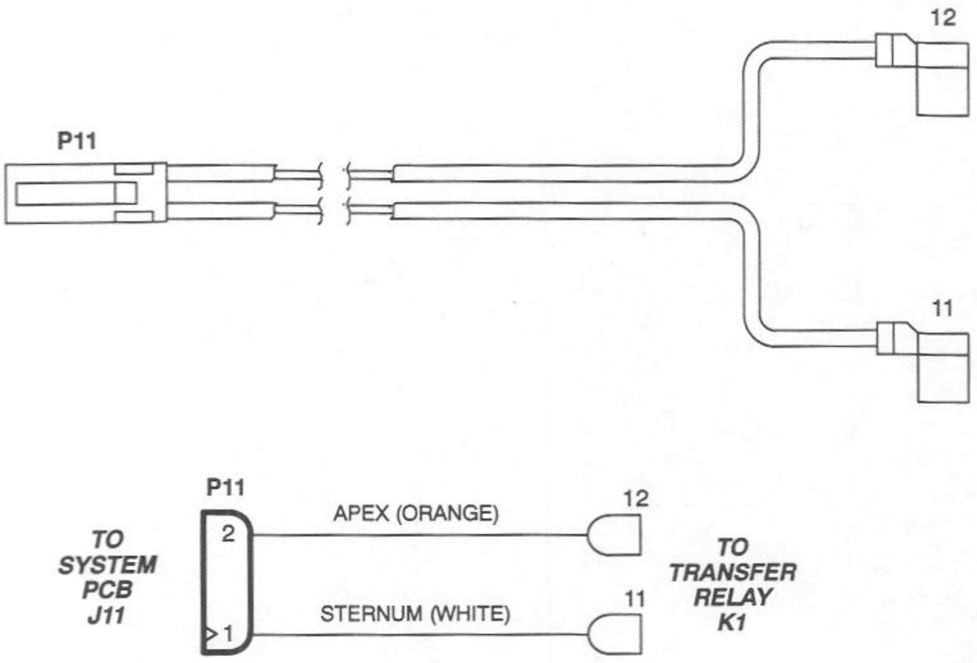
W3

Figure 5-19 Charger Output Wire Harness
Part Number 805115-00


L1
L2
6
P52
11A
9
12A
P50
L1
(RED)
L2
6
TO TRANSFER RELAY K1
P52
P50
TO RELAY MOUNT
(RED)
(RED)
12A
(RED)
11A
(RED)
9
TO TRANSFER RELAY K1

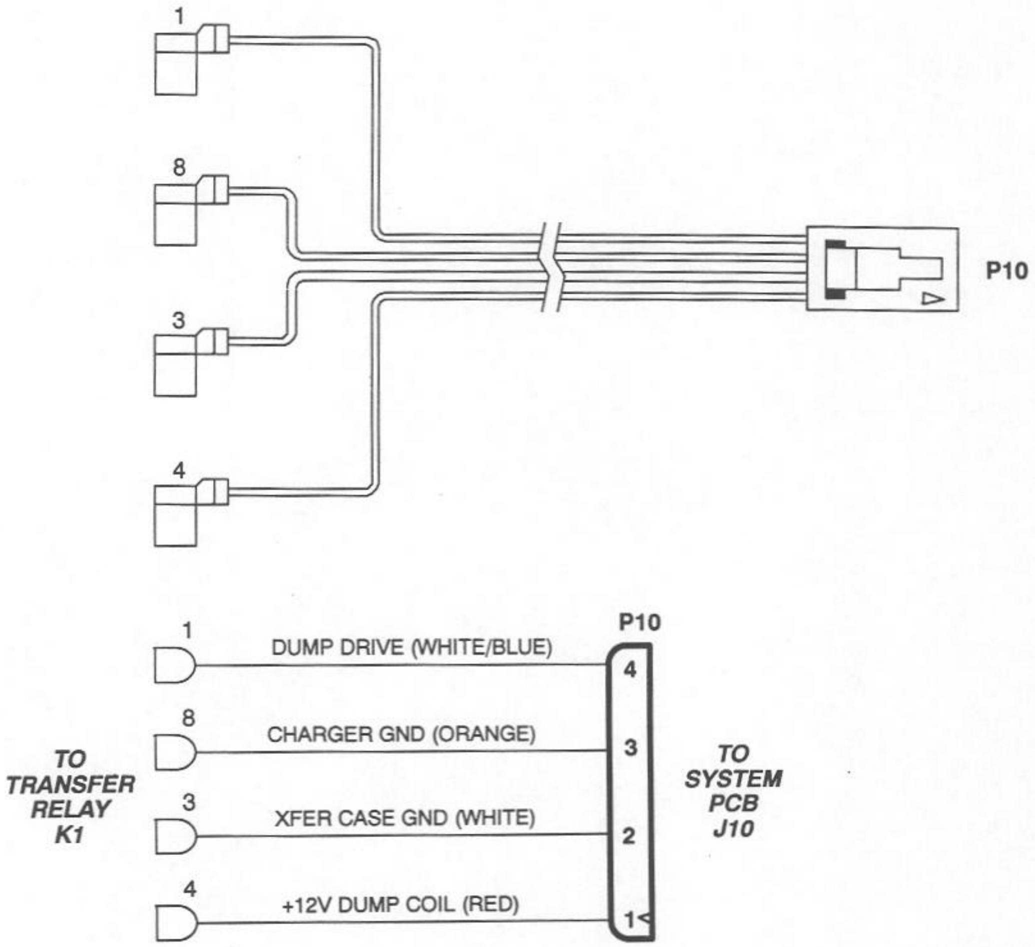
W4

Figure 5-20 Inductor/Relay Wire Harness
Part Number 805115-14


12
P11
11
P11
APEX (ORANGE)
12
TO SYSTEM PCB J11
2
TO TRANSFER RELAY K1
11
1
STERNUM (WHITE)

W5

Figure 5-21 QUIK-LOOK, Apex, Sternum Wire Harness
Part Number 805115-03


1
8
3
4
P10
1
DUMP DRIVE (WHITE/BLUE)
8
CHARGER GND (ORANGE)
3
XFER CASE GND (WHITE)
4
+12V DUMP COIL (RED)
P10
4
3
2
1
TO TRANSFER RELAY K1
TO SYSTEM PCB J10

W6

Figure 5-22 System PCB-Relay Wire Harness
Part Number 805115-04

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